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Argon I Lines Produced in a Hollow Cathode Source, 332 nm *to* 5865 nm

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We report precision measurements by Fourier transform spectroscopy of the vacuum wavenumber, line width, and relative signal strength of 928 lines in the Ar I spectrum. Wavelength in air and classification of the transition are supplied for each line. A comparison of our results with other precision measurements illustrates the sensitivity of Ar I wavelengths to conditions in the light source.

Key words: argon; atomic spectra; Fourier transform spectroscopy; wavelengths, pressure shifts.

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Foreword

Spectra of the noble gases are frequently observed in laboratory discharges, industrial plasmas, lighting discharges, sources for analytical spectrochemistry, and astrophysical sources. In response to the wide interest in these elements the NIST Atomic Spectroscopy Data Center is currently compiling the spectra and energy levels for all ionization stages of Ne, Ar, Kr, and Xe. A critical review of the literature revealed that no comprehensive description of the infrared spectrum of neutral argon has ever been published.

In 1995 observations of the spectrum of singly ionized argon covering the range 222 nm to 5865 nm were published by Whaling, Anderson, Carle, Brault, and Zarem [J. Quant. Spectros. Radiat. Transfer **53**, 1 (1995)]. Their measurements, made with the high-resolution Fourier Transform Spectrometer at the National Solar Observatory (Kitt Peak), have been widely used as a source of wavelength standards. Measurements of neutral argon from the same spectra have been circulated as an unpublished line list. This list has been used in a number of laboratories to identify lines of argon in spectral sources and as a source of calibration wavelengths.

This article presents the comprehensive list of neutral argon observations from the Kitt Peak spectra over a wide wavelength region from the near ultraviolet to near infrared and describes the experimental conditions under which the measurements were made. It was prepared by Ward Whaling for publication in the NIST Journal of Research with the encouragement and assistance of the Atomic Spectroscopy Data Center in order

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to make these data available to the broad community of users and to adequately document the work so that its results can be integrated with other available data in our argon compilation.

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1. Introduction

Argon is frequently used to sustain the discharge in a hollow cathode spectral source, and the source typically excites the first, second, and third spectra of argon as well as the spectrum of the cathode material. Consequently, a complete picture of the argon spectrum is useful in avoiding, or correcting for, interference between argon lines and lines from the cathode material. In this paper we provide such a line list for Ar I; similar line lists for Ar II [1] and Ar III [2] have been published earlier.

2. Experimental Method

Argon lines were obtained by comparing many high-resolution spectra of a hollow cathode discharge in argon, with *different* cathode materials for the different spectra. By extracting lines common to several spectra, regardless of the cathode material, we have generated a list of lines arising from the argon that supports the discharge, or from a common contaminant as discussed below.

All spectra were recorded on the 1 m vacuum Fourier transform spectrometer [3] at the National Solar Observatory (Kitt Peak). Hollow cathode spectra from the Kitt Peak archive with cathodes of Co, Cu, Fe, Mo, Ti, V, and Y were measured for this work; the Kitt Peak National Observatory archive designation of each spectrum is given in Ref. [1]. The cathode cavity was 25 mm long by 8 mm diameter; further details of the water-cooled source will be found in Ref. [1]. The source pressure varied from one spectrum to another between 270 Pa and 530 Pa (2 Torr and 4 Torr) of high purity argon, with discharge currents between 150 mA and 600 mA.

All spectra were measured with the DECOMP [4] line-finding program developed by Brault. This program fits a Voigt profile to the spectral feature and records the line-center, peak amplitude, full width at half maximum intensity (FWHM), and other parameters of the Voigt profile.

3. Results

In the first column of Table 1 we list the line-center vacuum wavenumber (in cm^{-1}), followed by the experimental uncertainty in column 2. The ratio of the peak amplitude S to the root mean square background noise N appears in column 3 as the $\log_{10}(S/N)$ for each line. Note that the peak amplitude has not been corrected for the spectrometer response. Over the range of a given spectrum, the spectrometer response may vary by an order of magnitude, and the comparison of the signal-to-noise ratio of two lines is a reliable indication of the relative strength of the lines only if they are close in wavelength. The full width of the observed line (in 10^{-3} cm^{-1}) at half maximum height appears in the 4th column. The absolute value of the line width depends on source and instrumental conditions, but the increased relative width of lines from levels of high excitation and high angular momentum is an aid in identification.

The uncertainty $\Delta\sigma$ in the line-center wavenumber appears in the second column. This experimental uncertainty (one standard deviation level) comes from two sources: (1) the uncertainty $\Delta\sigma_L$ in locating the center of the line in the presence of noise, and (2) $\Delta\sigma_S$ from the uncertainty in the scale of the FTS. We combine these to find the overall uncertainty in the wave number: $\Delta\sigma = [(\Delta\sigma_L)^2 + (\Delta\sigma_S)^2]^{1/2}$.

(1) We evaluate the uncertainty in locating the line center from $\Delta\sigma_L = 0.5(W)/(S/N)$, where W (the FWHM) and S/N (the signal-to-noise ratio) appear in Table 1, and the factor 0.5 is an approximation to the more precise factor given by Davis, Abrams, and Brault [5]. For very strong lines ($S/N > 10^4$) this expression may underestimate $\Delta\sigma_L$ because it neglects self-absorption that may, if asymmetric, shift the line center, and it neglects the local increase in the noise level under a strong line in the FTS spectrum [6]. We therefore set a lower limit on $\Delta\sigma_L$ of 0.0003 cm^{-1}. The argument supporting this limiting value is presented in Ref. [1].

(2) Wavenumbers measured with the FTS must be multiplied by a scale factor s to correct for any angular deviation between the path followed by light from the source as it passes through the instrument and the path followed by the laser beam that measures the displacement of the FTS mirror. The scale factor s is a constant (~ 1) for a given spectrum and is determined empirically by measuring with the FTS standard lines of accurately known wavenumber; s = (standard wavenumber)/(measured wavenumber). Any uncertainty Δs in the determination of s contributes a proportional uncertainty in the corrected wavenumber σ given by $\Delta\sigma_S = \sigma(\Delta s/s)$. The factor in parentheses was typically (3 to 7) $\times 10^{-8}$ for the different spectra that we measured. We adopt as the

uncertainty Δs for a particular spectrum the standard deviation in the mean value of s derived from measurements of 28 Ar II standard lines in that spectrum.

As standards we used as many as possible of the 28 Ar II lines recommended by Learner and Thorne [7]. These well isolated lines of good strength from transitions between low excitation levels should be minimally sensitive to pressure in the source. Our wavenumbers for these Ar II standard lines were taken from Ref. [1] and derive ultimately from the CO molecular lines used to calibrate the Ar II spectra [8]. Our Ar II wavenumbers are slightly higher than the values reported by Norlén [9]. For the 28 Ar II standard lines, the mean value of the ratio σ (based on CO)/σ (Norlén) is $[1 + 67(8) \times 10^{-9}]$.

The list of argon wavenumbers collected by comparing different spectra was then compared with line lists in the literature for Ar I, Ar II, and Ar III—notably those of Minnhagen [10], Striganov and Sventitskii [11], and Kurucz and Peytremann [12]—to identify the ion and classify the transition. Additional Ar I lines with wavelengths longer than those in existing compilations were identified by calculating all electric dipole transition energies allowed by parity and J-value selection rules, using Ar I level energies from Moore [13] as expanded and refined by level energies from Minnhagen [10] and Norlén [9]. In Table 1, we identify the transition upper level in columns 5–7 by its energy, J-value, and orbital, and the lower level in columns 8–10. When individual J levels could not be resolved, the [K] value (the result of coupling the total angular momentum J_1 of the $3p^5$ core with the orbital angular momentum l of the valence electron) is given. The last column gives the wavelength in air as determined from the vacuum wavenumber by a formula from Edlén [14].

Ar II and Ar III lines were identified and classified in the same way. When all Ar I, II, and III lines had been removed from the list of common lines, we searched for possible contaminants that might be common to all our spectra by searching for the strongest lines in the spectra of H, He, C, N, O, Ne, Na, and Fe. A few H, C, and O lines were found, readily identified as coming from a low-mass contaminant by their broad Doppler widths. On the Cu cathode spectrum between 2000 cm^{-1} and 3000 cm^{-1}, molecular lines from ArH^+ were abundant and strong (S/N up to 10^2).

With all known Ar and contaminant lines removed, the 114 common lines left over are presumably from Ar. By comparing the relative intensity of these unidentified lines in spectra recorded at different power levels, we conclude that most come from an Ar ion. Four unidentified lines that appear to come from Ar I are included in Table 1 with no designation.

4. Comparison With Other Line Lists

Our Ar I wavelengths agree with those of Minnhagen [10] within the modest precision he assigns: "better than 10 mÅ for lines that are not too weak." Our agreement with Norlén's [9] wavenumbers is generally within (1 or 2) $\times 10^{-3}$ cm^{-1}, as might be expected from the close agreement of his calculated wavenumbers for Ar II with the values we used to calibrate the FTS scale. Norlén's calculated wavenumbers are essentially averages over many alternate (Ritz-equivalent) paths that reduce the uncertainty of his values well below that which we are able to achieve in a single measurement, especially for weak lines. Hence Norlén's values, multiplied by $[1 + 67(8) \times 10^{-9}]$, are to be preferred to those in Table 1 when available.

Palmeri and Biemont [15] have measured 100 transitions from $4f$, $5g$, and $6g$ levels in Ar I, using spectra recorded with the same FTS used in the present experiment. In their hollow cathode source they used various Ar pressures but all were lower than ours; their average pressure of about 130 Pa (1 Torr) was lower than ours by a factor of 1/3. For the $4f \rightarrow 3d$ transitions (66 lines), our wavenumbers agree beautifully with theirs; the mean deviation between the two sets of wavenumbers is $0.4(1.1) \times 10^{-3}$ cm^{-1}. For the $5g \rightarrow 4f$ and $6g \rightarrow 4f$ transitions (33 lines), our wavenumbers are, on average, greater than theirs by 6×10^{-3} cm^{-1}. We attribute this difference to a pressure effect that appears to be strongly dependent on the angular momentum of the levels involved. This difference did not show up in our comparison with Norlén's wavenumbers, even though his source pressure was lower than ours by a factor of 1/10, because the shift depends on the angular momentum of the levels involved and Norlén measured only transitions between s, p, and d orbitals in Ar I.

Any interaction between an excited Ar atom and neighboring atoms that shifts the energy of an excited level will also broaden it, and this effect is clearly seen in Table 1. For example, transitions near 3800 cm^{-1} from the $6g$ levels in Ar I have an average width $\approx 300 \times 10^{-3}$ cm^{-1}, while nearby lines from $4d'$ and $5p'$ upper levels have widths between (18 and 22) $\times 10^{-3}$ cm^{-1}. The dependence on l appears to be greater than the dependence on n; nine lines from $7p$ configurations in the same (3600 to 4000) cm^{-1} range have an average width of 38×10^{-3} cm^{-1}. In these examples, the lines are only broadened and shifted at the pressure (270 Pa to 530 Pa) of our source, but the lines may not be seen at all from a source at higher pressure. Palmeri and Biemont [15] report lines near 2100 cm^{-1} from $7g$ and $7h$ levels of Ar I that are broadened beyond recognition as lines on our spectra.

We conclude that the gas pressure in our hollow cathode source has *increased* the wavenumber of some lines from levels of high l or n. The shifted lines display a width noticeably greater than that of nearby transitions between s, p, and d levels. The wavenumbers, line widths, and relative signal amplitudes in the table are those one can expect to see from a hollow cathode discharge in Ar at a pressure of a few hundred Pa.

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)
1704.5679	.0008	1.10	21	121271	2	6*p*	119566	3	4*d*	5864.9902
1710.0644	.0005	1.23	18	121470	0	6*p*	119760	1	6*s*	5846.1389
1723.0187	.0003	2.23	15	118907	2	4*d*	117184	2	5*p*	5802.1855
1746.9721	.0004	1.36	17	121192	2	6*p*	119445	2	4*d*	5722.6295
1755.2831	.0003	1.71	15	118907	2	4*d*	117151	1	5*p*	5695.5337
1778.6263	.0003	1.45	19	122791	0	6*p*′	121012	1	4*d*′	5620.7838
1786.1520	.0016	0.84	22	122036	4	5*d*	120250	4	4*f*	5597.1015
1798.3588	.0003	1.77	14	116660	1	5*p*	114862	0	5*s*′	5559.1098
1806.8168	.0005	1.30	19	121655	2	4*f*′	119848	1	4*d*	5533.0867
1812.3256	.0003	2.26	19	121257	1	6*p*	119445	2	4*d*	5516.2681
1816.7271	.0005	1.18	15	117184	2	5*p*	115367	1	3*d*′	5502.9035
1825.7821	.0008	1.15	23	121271	2	6*p*	119445	2	4*d*	5475.6118
1828.9313	.0003	2.15	21	122036	4	5*d*	120207	5	4*f*	5466.1834
1850.9071	.0050	0.48	30	123505	2	5*d*′	121655	2	4*f*′	5401.2835
1852.2026	.0003	3.53	16	118512	0	4*d*	116660	1	5*p*	5397.5056
1853.5579	.0046	1.00	91	124136	3	5*f*′	122282	2	5*d*	5393.5590
1854.8601	.0003	2.15	15	116660	1	5*p*	114805	2	3*d*′	5389.7725
1856.8485	.0008	1.11	20	122087	2	5*d*	120230	2	4*f*	5384.0008
1857.1584	.0003	2.50	21	122087	2	5*d*	120230	3	4*f*	5383.1024
1881.5954	.0003	2.98	18	122635	2	6*p*′	120753	3	4*d*′	5313.1900
1898.2640	.0003	1.71	22	122087	2	5*d*	120189	2	4*f*	5266.5350
1898.6772	.0011	0.95	20	122087	2	5*d*	120188	1	4*f*	5265.3889
1903.1812	.0054	0.50	34	123557	3	5*d*′	121654	3	4*f*′	5252.9280
1904.1373	.0003	1.94	26	123557	3	5*d*′	121653	4	4*f*′	5250.2904
1907.2839	.0003	2.36	15	118907	2	4*d*	116999	2	5*p*	5241.6286
1910.2258	.0003	1.45	17	122160	3	5*d*	120250	4	4*f*	5233.5561
1910.2660	.0005	1.61	41	122160	3	5*d*	120250	3	4*f*	5233.4459
1930.0838	.0095	0.47	56	122160	3	5*d*	120230	2	4*f*	5179.7098
1930.3927	.0020	0.84	27	122160	3	5*d*	120230	3	4*f*	5178.8810
1942.2126	.0014	1.43	73	122696	4	5*f*	120753	3	4*d*′	5147.3634
1952.4926	.0003	2.51	19	121165	3	6*p*	119213	3	4*d*	5120.2621
1952.9706	.0003	2.48	23	122160	3	5*d*	120207	4	4*f*	5119.0089
1963.8546	.0003	1.77	16	118907	2	4*d*	116943	3	5*p*	5090.6386
1964.3675	.0030	1.30	121	122718	3	5*f*	120753	3	4*d*′	5089.3094
1971.1566	.0020	0.52	13	121654	3	4*f*′	119683	2	6*s*	5071.7807
1975.5468	.0043	0.95	76	124136	4	5*f*′	122160	3	5*d*	5060.5098
1978.9326	.0003	3.25	18	121192	2	6*p*	119213	3	4*d*	5051.8517
1990.6309	.0003	2.49	20	122610	1	6*p*′	120619	2	4*d*′	5022.1635
1991.3992	.0003	3.61	15	118651	1	4*d*	116660	1	5*p*	5020.2259
2000.3339	.0003	1.57	21	122601	1	6*p*′	120601	2	4*d*′	4997.8026
2007.1430	.0011	0.70	11	124715	3	7*d*	122708	3	5*f*	4980.8478
2010.6171	.0035	0.67	33	123172	1	7*p*	121161	1	6*s*′	4972.2416
2024.3074	.0003	1.75	15	116999	2	5*p*	114975	1	5*s*′	4938.6145
2029.2808	.0003	2.47	16	119213	3	4*d*	117184	2	5*p*	4926.5108
2032.2207	.0003	2.20	26	122282	2	5*d*	120250	3	4*f*	4919.3839
2034.1767	.0003	2.20	19	122635	2	6*p*′	120601	2	4*d*′	4914.6536
2050.2908	.0012	1.52	78	124137	3	5*f*′	122087	2	5*d*	4876.0273

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
2052.0339	.0004	1.50	26	122282	2	5d	120230	2	4f	4871.8853	
2057.7439	.0003	1.49	21	121271	2	6p	119213	3	4d	4858.3664	
2067.0419	.0054	0.66	49	122686	1	5f	120619	2	4d′	4836.5124	
2067.3880	.0023	1.09	56	122686	2	5f	120619	2	4d′	4835.7027	
2075.0395	.0004	1.13	11	125330	2	10s	123255	1	7p	4817.8716	
2075.3327	.0029	0.67	27	123172	1	7p	121097	0	6s′	4817.1909	
2079.7502	.0003	2.24	28	122330	3	5d	120250	4	4f	4806.9589	
2080.8897	.0003	4.77	16	119024	4	4d	116943	3	5p	4804.3266	
2085.5130	.0011	1.45	61	122686	2	5f	120601	2	4d′	4793.6761	
2087.2321	.0003	1.73	18	121653	4	4f′	119566	3	4d	4789.7279	
2088.1848	.0004	1.34	18	121654	3	4f′	119566	3	4d	4787.5427	
2088.8664	.0012	1.56	86	122708	3	5f	120619	2	4d′	4785.9805	
2089.1113	.0024	1.19	73	122708	2	5f	120619	2	4d′	4785.4194	
2098.7920	.0051	1.21	164	122718	3	5f	120619	2	4d	4763.3466	B
2099.9107	.0004	1.53	28	122330	3	5d	120230	3	4f	4760.8090	
2102.3065	.0003	1.71	31	123373	2	5d′	121271	2	6p	4755.3836	
2106.9917	.0005	1.86	78	122708	3	5f	120601	2	4d′	4744.8093	
2115.7642	.0024	0.78	29	123373	2	5d′	121257	1	6p	4725.1361	
2120.5669	.0007	1.24	25	123774	3	6d	121653	4	4f′	4714.4345	
2120.8171	.0003	3.14	15	116943	3	5p	114822	3	3d′	4713.8783	
2122.4890	.0007	1.38	32	122330	3	5d	120207	4	4f	4710.1652	
2131.8359	.0003	3.34	17	120601	2	4d′	118469	2	5p′	4689.5137	
2140.9990	.0003	3.56	19	121012	1	4d′	118871	0	5p′	4669.4434	
2141.2904	.0003	3.84	17	120601	2	4d′	118460	1	5p′	4668.8080	
2141.7196	.0003	3.68	19	121165	3	6p	119024	4	4d	4667.8724	
2149.9613	.0003	2.00	16	120619	2	4d′	118469	2	5p′	4649.9785	
2153.0756	.0133	0.97	249	124871	4	7g	122718	4	5f	4643.2525	
2154.2720	.0033	0.84	45	123809	2	6d	121654	3	4f′	4640.6738	
2155.2844	.0005	1.16	15	123809	2	6d	121653	3	4f′	4638.4940	
2159.4158	.0003	3.60	17	120619	2	4d′	118460	1	5p′	4629.6196	
2160.9803	.0029	0.93	49	123816	1	5d′	121655	2	4f′	4626.2679	
2162.1254	.0003	2.66	20	121069	1	6p	118907	2	4d	4623.8177	
2171.5873	.0188	0.93	320	124867	5	7g	122696	5	5f	4603.6711	
2176.3085	.0003	2.14	15	117151	1	5p	114975	1	5s′	4593.6841	
2177.3877	.0003	2.82	15	116999	2	5p	114822	3	3d′	4591.4073	
2193.4579	.0003	3.57	17	120601	2	4d′	118407	1	5p′	4557.7687	
2194.1919	.0003	2.63	15	116999	2	5p	114805	2	3d′	4556.2440	
2196.0919	.0003	1.84	16	117563	0	5p	115367	1	3d′	4552.3021	
2196.7152	.0008	0.99	16	124357	2	8p	122160	3	5d	4551.0104	
2197.2121	.0003	3.70	17	119760	1	6s	117563	0	5p	4549.9812	
2204.5860	.0015	1.37	71	124137	2	5f′	121933	1	5d	4534.7624	
2208.4057	.0003	2.65	18	121653	3	4f′	119445	2	4d	4526.9190	
2208.5727	.0003	3.14	15	117184	2	5p	114975	1	5s′	4526.5767	
2209.3987	.0005	1.25	18	121654	3	4f′	119445	2	4d	4524.8844	
2209.7454	.0003	1.57	19	121655	2	4f′	119445	2	4d	4524.1744	
2211.5834	.0003	4.03	17	120619	2	4d′	118407	1	5p′	4520.4145	
2213.5460	.0003	4.46	16	119213	3	4d	116999	2	5p	4516.4065	
2246.6156	.0003	3.99	16	118907	2	4d	116660	1	5p	4449.9264	
2248.3218	.0011	0.95	19	123505	2	5d′	121257	1	6p	4446.5494	
2251.7588	.0044	0.56	32	123509	0	6d	121257	1	6p	4439.7624	
2258.7548	.0005	1.27	18	121165	3	6p	118907	2	4d	4426.0112	
2261.2421	.0003	2.98	17	119445	2	4d	117184	2	5p	4421.1427	
2270.1168	.0003	3.75	16	119213	3	4d	116943	3	5p	4403.8589	
2284.4171	.0003	4.27	17	120753	3	4d′	118469	2	5p′	4376.2910	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
2284.8056	.0003	3.97	19	119848	1	4*d*	117563	0	5*p*	4375.5469	
2285.1957	.0003	2.02	20	121192	2	6*p*	118907	2	4*d*	4374.7999	
2289.6911	.0003	2.36	15	117151	1	5*p*	114862	0	5*s*′	4366.2108	
2290.3931	.0003	2.40	17	121161	1	6*s*′	118871	0	5*p*′	4364.8726	
2293.5068	.0003	4.18	17	119445	2	4*d*	117151	1	5*p*	4358.9467	
2301.7641	.0003	1.98	16	116943	3	5*p*	114641	2	3*d*′	4343.3095	
2312.9381	.0035	1.12	93	124349	3	8*p*	122036	4	5*d*	4322.3266	
2313.6761	.0014	0.90	22	123505	2	5*d*′	121192	2	6*p*	4320.9479	
2325.5328	.0009	1.32	38	122514	1	5*d*	120189	2	4*f*	4298.9176	
2346.1926	.0003	2.48	16	117151	1	5*p*	114805	2	3*d*′	4261.0628	
2350.5497	.0003	2.29	19	121257	1	6*p*	118907	2	4*d*	4253.1642	
2358.3348	.0003	3.05	15	116999	2	5*p*	114641	2	3*d*′	4239.1241	
2361.6531	.0003	2.94	16	117184	2	5*p*	114822	3	3*d*′	4233.1678	
2364.0065	.0003	3.30	19	121271	2	6*p*	118907	2	4*d*	4228.9536	
2365.6102	.0008	1.17	24	123557	3	5*d*′	121192	2	6*p*	4226.0867	
2378.4572	.0003	3.68	16	117184	2	5*p*	114805	2	3*d*′	4203.2599	
2382.4561	.0003	4.39	17	119566	3	4*d*	117184	2	5*p*	4196.2049	
2392.0485	.0018	0.85	25	123557	3	5*d*′	121165	3	6*p*	4179.3776	
2399.2345	.0008	1.33	33	123468	1	6*d*	121069	1	6*p*	4166.8598	
2417.3418	.0003	2.91	20	121069	1	6*p*	118651	1	4*d*	4135.6476	
2440.1867	.0015	1.02	31	123509	0	6*d*	121069	1	6*p*	4096.9299	
2440.4078	.0003	2.96	18	121653	4	4*f*′	119213	3	4*d*	4096.5587	
2441.3600	.0003	1.60	17	121654	3	4*f*′	119213	3	4*d*	4094.9609	
2441.7057	.0018	0.71	18	121655	2	4*f*′	119213	3	4*d*	4094.3811	
2445.5073	.0003	3.97	17	119445	2	4*d*	116999	2	5*p*	4088.0163	
2459.5585	.0038	0.96	69	122709	[2.5]	5*g*	120250	4	4*f*	4064.6619	B
2459.5811	.0103	0.76	119	122709	[2.5]	5*g*	120250	3	4*f*	4064.6246	B
2465.6143	.0063	0.48	38	123936	1	8*s*	121470	0	6*p*	4054.6787	
2469.5656	.0003	2.37	66	122719	[3.5]	5*g*	120250	4	4*f*	4048.1912	B
2469.5987	.0003	2.43	100	122719	[3.5]	5*g*	120250	3	4*f*	4048.1370	B
2473.0739	.0003	3.07	44	122723	[4.5]	5*g*	120250	4	4*f*	4042.4484	B
2473.1102	.0003	3.47	87	122723	4	5*g*	120250	3	4*f*	4042.3891	
2479.4116	.0003	2.18	29	122709	[2.5]	5*g*	120230	2	4*f*	4032.1154	
2479.7056	.0003	2.48	57	122709	[2.5]	5*g*	120230	3	4*f*	4031.6374	B
2487.7965	.0012	1.14	34	123653	4	6*d*	121165	3	6*p*	4018.5255	
2489.4120	.0003	3.18	65	122719	3	5*g*	120230	2	4*f*	4015.9177	
2489.7220	.0003	3.32	67	122719	[3.5]	5*g*	120230	3	4*f*	4015.4177	B
2493.9253	.0003	2.86	57	124149	3	5*g*	121655	2	4*f*	4008.6500	
2494.2737	.0003	3.00	57	124148	[3.5]	5*g*	121654	3	4*f*	4008.0901	B
2495.0047	.0003	3.25	88	124148	[3.5]	5*g*	121653	3	4*f*	4006.9158	B
2495.2332	.0013	1.61	102	124148	[3.5]	5*g*	121653	4	4*f*	4006.5489	B
2499.4868	.0003	3.75	17	119683	2	6*s*	117184	2	5*p*	3999.7305	
2502.0780	.0003	2.74	17	119445	2	4*d*	116943	3	5*p*	3995.5883	
2505.6623	.0003	3.48	39	122713	[5.5]	5*g*	120207	4	4*f*	3989.8727	B
2505.7057	.0003	3.69	58	122713	[5.5]	5*g*	120207	5	4*f*	3989.8036	B
2510.3355	.0003	3.36	16	117151	1	5*p*	114641	2	3*d*′	3982.4453	
2512.2643	.0003	1.76	18	116660	1	5*p*	114148	1	3*d*	3979.3877	
2512.3413	.0048	0.98	92	122719	[3.5]	5*g*	120207	[4.5]	4*f*	3979.2658	B
2515.8301	.0003	2.19	78	122723	[4.5]	5*g*	120207	4	4*f*	3973.7475	B
2515.8629	.0003	2.26	109	122723	[4.5]	5*g*	120207	5	4*f*	3973.6957	B
2520.8112	.0003	3.31	56	122709	[2.5]	5*g*	120189	2	4*f*	3965.8955	B
2521.2210	.0003	3.08	60	122709	2	5*g*	120188	1	4*f*	3965.2508	
2531.7513	.0003	2.90	17	119683	2	6*s*	117151	1	5*p*	3948.7582	
2542.8637	.0003	3.20	19	121012	1	4*d*′	118469	2	5*p*′	3931.5020	

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
2552.3181	.0003	2.94	19	121012	1	4*d*′	118460	1	5*p*′	3916.9387	
2556.5390	.0003	2.56	21	121069	1	6*p*	118512	0	4*d*	3910.4718	
2566.7213	.0003	3.55	17	119566	3	4*d*	116999	2	5*p*	3894.9588	
2571.0392	.0136	0.44	75	123172	1	7*p*	120601	2	4*d*′	3888.4174	
2576.5772	.0003	3.43	17	119760	1	6*s*	117184	2	5*p*	3880.0598	
2587.9374	.0003	1.73	16	117563	0	5*p*	114975	1	5*s*′	3863.0276	
2604.4858	.0003	2.76	19	121012	1	4*d*′	118407	1	5*p*′	3838.4827	
2605.7661	.0003	2.19	20	121257	1	6*p*	118651	1	4*d*	3836.5967	
2608.8419	.0003	3.80	17	119760	1	6*s*	117151	1	5*p*	3832.0734	
2619.2228	.0003	2.42	20	121271	2	6*p*	118651	1	4*d*	3816.8855	
2623.2920	.0003	3.86	18	119566	3	4*d*	116943	3	5*p*	3810.9648	
2625.0351	.0014	1.00	28	123882	1	7*s*′	121257	1	6*p*	3808.4342	
2632.5850	.0017	1.16	48	123903	2	8*s*	121271	2	6*p*	3797.5122	
2637.0050	.0003	3.18	19	121097	0	6*s*′	118460	1	5*p*′	3791.1470	
2664.1706	.0003	2.52	19	119848	1	4*d*	117184	2	5*p*	3752.4900	
2665.2399	.0030	0.90	48	123936	1	8*s*	121271	2	6*p*	3750.9845	
2678.6952	.0021	1.12	55	123936	1	8*s*	121257	1	6*p*	3732.1430	
2683.7523	.0003	3.44	18	119683	2	6*s*	116999	2	5*p*	3725.1104	
2689.1726	.0003	3.27	18	121097	0	6*s*′	118407	1	5*p*′	3717.6021	
2690.3873	.0012	1.02	26	123882	1	7*s*′	121192	2	6*p*	3715.9236	
2692.2580	.0003	3.86	18	121161	1	6*s*′	118469	2	5*p*′	3713.3416	
2696.4354	.0003	4.11	19	119848	1	4*d*	117151	1	5*p*	3707.5888	
2701.7123	.0003	3.65	18	121161	1	6*s*′	118460	1	5*p*′	3700.3473	
2711.4036	.0003	1.98	15	123903	2	8*s*	121192	2	6*p*	3687.1212	B
2725.0243	.0067	0.65	60	125335	0	8*s*′	122610	1	6*p*′	3668.6916	
2737.8368	.0006	1.59	44	123903	2	8*s*	121165	3	6*p*	3651.5229	
2740.3226	.0003	4.28	18	119683	2	6*s*	116943	3	5*p*	3648.2105	
2744.0525	.0009	1.37	40	123936	1	8*s*	121192	2	6*p*	3643.2516	
2744.9632	.0003	1.72	21	121257	1	6*p*	118512	0	4*d*	3642.0429	
2747.6223	.0003	3.57	18	121654	3	4*f*′	118907	2	4*d*	3638.5182	
2747.9691	.0003	2.44	18	121655	2	4*f*′	118907	2	4*d*	3638.0590	
2753.4613	.0026	0.70	26	122601	1	6*p*′	119848	1	4*d*	3630.8023	
2753.8798	.0003	3.82	18	121161	1	6*s*′	118407	1	5*p*′	3630.2505	
2760.8424	.0003	4.08	18	119760	1	6*s*	116999	2	5*p*	3621.0954	
2784.8409	.0012	0.85	17	119445	2	4*d*	116660	1	5*p*	3589.8904	
2813.4539	.0039	0.60	31	123882	1	7*s*′	121069	1	6*p*	3553.3810	
2818.8415	.0003	2.03	20	121470	0	6*p*	118651	1	4*d*	3546.5895	
2834.4679	.0017	1.19	54	123903	2	8*s*	121069	1	6*p*	3527.0371	
2838.2967	.0023	1.25	83	122686	1	5*f*	119848	1	4*d*	3522.2792	
2838.6384	.0003	2.52	58	122686	2	5*f*	119848	1	4*d*	3521.8552	
2848.4359	.0003	2.15	20	119848	1	4*d*	116999	2	5*p*	3509.7414	
2851.5955	.0003	2.28	17	116999	2	5*p*	114148	1	3*d*	3505.8526	
2860.3627	.0003	2.43	81	122708	2	5*f*	119848	1	4*d*	3495.1069	
2874.8957	.0039	0.64	34	122635	2	6*p*′	119760	1	6*s*	3477.4387	
2918.1446	.0007	1.17	21	122601	1	6*p*′	119683	2	6*s*	3425.9006	
2926.5652	.0036	0.69	35	122610	1	6*p*′	119683	2	6*s*	3416.0433	
2942.7840	.0072	0.59	56	122791	0	6*p*′	119848	1	4*d*	3397.2162	
2947.9582	.0023	1.30	90	122708	2	5*f*	119760	1	6*s*	3391.2534	
2976.1176	.0023	1.23	78	124137	2	5*f*′	121161	1	6*s*′	3359.1661	
3003.1852	.0003	2.94	19	121655	2	4*f*′	118651	1	4*d*	3328.8900	
3003.5961	.0003	4.16	17	117151	1	5*p*	114148	1	3*d*	3328.4346	
3016.7344	.0003	4.10	16	116660	1	5*p*	113643	1	5*s*	3313.9388	
3023.0838	.0003	3.94	18	119683	2	6*s*	116660	1	5*p*	3306.9785	
3024.8017	.0022	1.32	90	122708	3	5*f*	119683	2	6*s*	3305.1004	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
3035.8606	.0003	2.43	17	117184	2	5p	114148	1	3d	3293.0607	
3040.5660	.0003	3.57	18	118407	1	5p′	115367	1	3d′	3287.9646	
3061.9268	.0003	2.51	21	121933	1	5d	118871	0	5p′	3265.0269	
3069.0179	.0011	1.04	25	122635	2	6p′	119566	3	4d	3257.4829	
3092.7336	.0003	3.57	18	118460	1	5p′	115367	1	3d′	3232.5038	
3095.4093	.0003	3.01	15	111818	1	3d	108723	0	4p′	3229.7096	
3100.1742	.0003	3.25	18	119760	1	6s	116660	1	5p	3224.7456	
3102.1880	.0003	2.81	18	118469	2	5p′	115367	1	3d′	3222.6523	
3120.3530	.0033	1.00	65	122686	2	5f	119566	3	4d	3203.8917	
3125.5136	.0004	1.96	74	124137	2	5f′	121012	1	4d′	3198.6017	
3129.6340	.0003	2.05	61	122696	4	5f	119566	3	4d	3194.3905	
3141.8337	.0004	2.03	75	122708	3	5f	119566	3	4d	3181.9867	
3143.1718	.0013	1.08	32	123373	2	5d′	120230	3	4f	3180.6321	
3151.7997	.0003	2.60	92	122718	4	5f	119566	3	4d	3171.9253	
3164.8110	.0006	1.25	22	122610	1	6p′	119445	2	4d	3158.8847	
3187.7678	.0003	2.01	20	119848	1	4d	116660	1	5p	3136.1359	
3191.5209	.0003	4.70	17	116660	1	5p	113468	2	5s	3132.4479	
3226.2014	.0003	3.64	17	116943	3	5p	113717	3	3d	3098.7752	
3234.0312	.0003	2.09	24	116660	1	5p	113426	2	3d	3091.2729	B
3255.6064	.0111	0.43	60	123505	2	5d′	120250	3	4f	3070.7867	
3263.2924	.0006	1.81	78	122708	2	5f	119445	2	4d	3063.5541	
3272.9837	.0003	2.40	91	122718	3	5f	119445	2	4d	3054.4830	
3279.3267	.0039	0.90	62	123468	1	6d	120189	2	4f	3048.5749	
3279.7342	.0042	0.70	42	123468	1	6d	120188	1	4f	3048.1961	
3282.7720	.0003	3.49	17	116999	2	5p	113717	3	3d	3045.3753	
3320.6895	.0044	0.71	45	123509	0	6d	120188	1	4f	3010.6015	
3334.4971	.0003	1.91	21	121794	0	5d	118460	1	5p′	2998.1351	
3350.2442	.0019	0.94	33	123557	3	5d′	120207	4	4f	2984.0430	
3356.0661	.0003	4.96	17	116999	2	5p	113643	1	5s	2978.8665	
3382.2227	.0003	2.34	68	124136	4	5f′	120753	3	4d′	2955.8292	
3383.7324	.0044	0.95	78	124137	3	5f′	120753	3	4d′	2954.5105	
3386.6647	.0009	1.09	23	121794	0	5d	118407	1	5p′	2951.9523	
3403.2640	.0077	0.53	52	123653	4	6d	120250	4	4f	2937.5543	
3407.1346	.0013	1.13	35	123255	1	7p	119848	1	4d	2934.2171	
3415.2255	.0003	3.77	18	117563	0	5p	114148	1	3d	2927.2658	
3417.2967	.0003	3.43	19	120601	2	4d′	117184	2	5p	2925.4916	
3422.1922	.0006	1.31	22	122635	2	6p′	119213	3	4d	2921.3066	
3432.4115	.0003	4.12	17	118407	1	5p′	114975	1	5s′	2912.6090	
3435.4222	.0003	3.18	19	120619	2	4d′	117184	2	5p	2910.0565	
3444.4688	.0107	0.60	85	124610	4	7d	121165	3	6p	2902.4135	
3446.0344	.0004	1.67	36	123653	4	6d	120207	5	4f	2901.0949	
3448.9604	.0009	1.07	22	121012	1	4d′	117563	0	5p	2898.6337	
3449.5614	.0003	2.95	19	120601	2	4d′	117151	1	5p	2898.1286	
3460.5026	.0006	1.39	31	123221	2	7p	119760	1	6s	2888.9655	
3463.7917	.0003	2.11	22	121933	1	5d	118469	2	5p′	2886.2222	
3467.0373	.0003	4.35	18	117184	2	5p	113717	3	3d	2883.5204	
3467.6864	.0003	1.57	20	120619	2	4d′	117151	1	5p	2882.9806	
3474.2819	.0064	0.12	17	116943	3	5p	113468	2	5s	2877.5076	
3482.0739	.0031	1.00	62	124643	1	7p′	121161	1	6s′	2871.0685	
3482.8101	.0003	2.74	60	122696	4	5f	119213	3	4d	2870.4616	
3484.5791	.0003	4.10	18	118460	1	5p′	114975	1	5s′	2869.0044	
3488.8505	.0008	1.36	35	123172	1	7p	119683	2	6s	2865.4918	
3494.0335	.0003	4.72	18	118469	2	5p′	114975	1	5s′	2861.2412	
3494.7287	.0008	1.25	27	123255	1	7p	119760	1	6s	2860.6720	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
3497.1292	.0020	0.97	38	124658	2	7p′	121161	1	6s′	2858.7084	
3501.3603	.0043	0.80	54	123262	2	7p	119760	1	6s	2855.2539	
3504.0525	.0003	3.47	19	118871	0	5p′	115367	1	3d′	2853.0602	
3504.9537	.0005	2.04	103	122718	3	5f	119213	3	4d	2852.3266	
3508.0666	.0003	4.81	18	117151	1	5p	113643	1	5s	2849.7956	
3516.6474	.0003	2.05	67	124136	3	5f′	120619	2	4d′	2842.8419	
3518.1904	.0008	1.67	69	124137	3	5f′	120619	2	4d′	2841.5951	
3522.7069	.0004	1.63	35	123206	3	7p	119683	2	6s	2837.9519	
3525.4137	.0003	2.05	23	121933	1	5d	118407	1	5p′	2835.7729	
3530.8526	.0003	4.34	17	116999	2	5p	113468	2	5s	2831.4047	
3534.7731	.0005	1.87	69	124136	3	5f′	120601	2	4d′	2828.2643	
3536.3163	.0003	2.09	73	124137	3	5f′	120601	2	4d′	2827.0301	
3536.5335	.0048	1.25	172	124137	2	5f′	120601	2	4d′	2826.8565	
3537.2741	.0017	1.20	55	123385	0	7p	119848	1	4d	2826.2646	
3537.5832	.0033	1.00	65	123221	2	7p	119683	2	6s	2826.0176	
3540.3313	.0003	4.46	18	117184	2	5p	113643	1	5s	2823.8240	
3545.7945	.0003	4.27	18	118407	1	5p′	114862	0	5s′	2819.4732	
3566.6722	.0026	1.07	61	123774	3	6d	120207	4	4f	2802.9693	
3569.8779	.0003	1.88	19	120753	3	4d′	117184	2	5p	2800.4522	
3573.3636	.0003	4.12	18	116999	2	5p	113426	2	3d	2797.7205	
3576.8590	.0039	0.83	53	123827	2	6d	120250	3	4f	2794.9865	
3578.4471	.0005	1.56	35	123809	2	6d	120230	2	4f	2793.7461	
3578.7552	.0026	0.95	47	123809	2	6d	120230	3	4f	2793.5055	
3582.4919	.0032	0.97	60	123832	3	6d	120250	4	4f	2790.5918	
3597.9620	.0003	4.18	18	118460	1	5p′	114862	0	5s′	2778.5931	
3598.3539	.0003	1.81	19	121161	1	6s′	117563	0	5p	2778.2905	
3602.2960	.0003	2.17	18	118407	1	5p′	114805	2	3d′	2775.2501	
3617.8589	.0003	2.18	24	122087	2	5d	118469	2	5p′	2763.3119	
3619.6875	.0003	2.70	19	120619	2	4d′	116999	2	5p	2761.9159	
3624.8701	.0008	1.42	40	123385	0	7p	119760	1	6s	2757.9671	
3627.3130	.0003	2.56	24	122087	2	5d	118460	1	5p′	2756.1097	
3639.7370	.0016	1.05	36	123206	3	7p	119566	3	4d	2746.7019	
3643.2630	.0039	0.84	54	122514	1	5d	118871	0	5p′	2744.0436	
3647.1139	.0003	4.30	18	118469	2	5p′	114822	3	3d′	2741.1462	
3654.4636	.0003	4.01	18	118460	1	5p′	114805	2	3d′	2735.6333	
3658.1322	.0006	1.18	19	120601	2	4d′	116943	3	5p	2732.8899	
3663.9180	.0003	3.01	18	118469	2	5p′	114805	2	3d′	2728.5743	
3671.9998	.0003	2.86	61	122696	5	5f	119024	4	4d	2722.5689	
3676.2657	.0003	1.96	37	120619	2	4d′	116943	3	5p	2719.4096	
3682.8532	.0003	3.98	18	117151	1	5p	113468	2	5s	2714.5454	
3691.0920	.0003	2.10	25	122160	3	5d	118469	2	5p′	2708.4864	
3694.2020	.0010	1.69	94	122718	[3.5]	5f	119024	4	4d	2706.2062	B
3694.6143	.0003	1.77	24	122601	1	6p′	118907	2	4d	2705.9042	
3695.4821	.0005	1.68	43	123262	2	7p	119566	3	4d	2705.2688	
3703.0354	.0007	1.21	21	122610	1	6p′	118907	2	4d	2699.7507	
3715.1178	.0003	4.79	18	117184	2	5p	113468	2	5s	2690.9705	
3725.3642	.0003	4.17	18	117151	1	5p	113426	2	3d	2683.5691	
3728.4570	.0015	0.88	23	122635	2	6p′	118907	2	4d	2681.3431	
3737.8865	.0028	0.91	45	124750	0	7p′	121012	1	4d′	2674.5789	
3754.1430	.0003	2.60	19	120753	3	4d′	116999	2	5p	2662.9973	
3757.6289	.0003	3.31	18	117184	2	5p	113426	2	3d	2660.5268	
3766.4389	.0003	4.12	18	118407	1	5p′	114641	2	3d′	2654.3036	
3775.8378	.0007	1.34	32	123221	2	7p	119445	2	4d	2647.6965	
3779.4472	.0047	0.87	69	122686	1	5f	118907	2	4d	2645.1679	

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
3779.7932	.0003	2.04	57	122686	2	5f	118907	2	4d	2644.9258	
3801.2718	.0003	2.27	76	122708	3	5f	118907	2	4d	2629.9810	
3810.0638	.0005	1.59	38	123255	1	7p	119445	2	4d	2623.9121	
3810.6389	.0036	0.74	40	124061	[3.5]	6g	120250	[3.5]	4f	2623.5161	B
3810.7137	.0003	2.90	20	120753	3	4d′	116943	3	5p	2623.4646	
3812.7985	.0051	1.24	178	124063	[4.5]	6g	120250	[3.5]	4f	2622.0301	B
3818.6059	.0008	1.13	20	118460	1	5p′	114641	2	3d′	2618.0425	
3825.0158	.0126	1.19	389	124055	[2.5]	6g	120230	2	4f	2613.6552	B
3825.3040	.0059	1.25	209	124055	[2.5]	6g	120230	3	4f	2613.4578	B
3828.0610	.0003	3.28	19	118469	2	5p′	114641	2	3d′	2611.5760	
3828.3245	.0003	2.83	22	121012	1	4d′	117184	2	5p	2611.3963	
3830.5014	.0106	1.21	343	124061	3	6g	120230	2	4f	2609.9122	
3830.7906	.0018	1.75	200	124061	[3.5]	6g	120230	3	4f	2609.7152	B
3836.2337	.0144	1.05	324	125491	[3.5]	6g′	121655	2	4f′	2606.0123	
3836.6027	.0062	1.25	222	125491	[3.5]	6g′	121654	3	4f′	2605.7617	B
3837.4857	.0311	0.62	259	125491	[4.5]	6g′	121653	[3.5]	4f′	2605.1621	B
3849.8042	.0008	2.29	307	124057	[5.5]	6g	120207	[4.5]	4f	2596.8262	B
3855.4906	.0165	0.97	307	124063	[4.5]	6g	120207	[4.5]	4f	2592.9962	B
3860.6123	.0009	1.18	26	122330	3	5d	118469	2	5p′	2589.5562	
3866.4002	.0026	1.76	294	124055	[2.5]	6g	120189	2	4f	2585.6797	B
3866.8038	.0036	1.61	294	124055	2	6g	120188	1	4f	2585.4098	
3874.6649	.0003	1.79	29	122282	2	5d	118407	1	5p′	2580.1644	
3895.8981	.0003	4.28	18	118871	0	5p′	114975	1	5s′	2566.1021	
3904.9717	.0006	1.49	36	124658	2	7p′	120753	3	4d′	2560.1395	
3919.6961	.0003	4.43	18	117563	0	5p	113643	1	5s	2550.5223	
3922.4009	.0003	3.73	19	116943	3	5p	113020	3	3d	2548.7635	
3940.8940	.0003	1.93	20	120601	2	4d′	116660	1	5p	2536.8031	
3945.2764	.0003	1.67	21	121097	0	6s′	117151	1	5p	2533.9852	
3959.0191	.0003	1.68	20	120619	2	4d′	116660	1	5p	2525.1892	
3977.7190	.0007	1.20	21	121161	1	6s′	117184	2	5p	2513.3178	
3978.9716	.0003	4.69	19	116999	2	5p	113020	3	3d	2512.5266	
3983.6714	.0007	1.28	24	122635	2	6p′	118651	1	4d	2509.5624	
3992.9132	.0013	1.20	42	123206	3	7p	119213	3	4d	2503.7539	
4007.7998	.0003	1.91	34	123221	2	7p	119213	3	4d	2494.4540	
4012.5897	.0003	1.57	23	121012	1	4d′	116999	2	5p	2491.4763	
4024.3750	.0012	1.20	38	124643	1	7p′	120619	2	4d′	2484.1800	
4034.6659	.0005	1.74	55	122686	1	5f	118651	1	4d	2477.8438	
4035.0096	.0003	2.12	57	122686	2	5f	118651	1	4d	2477.6328	
4042.4994	.0017	1.08	40	124643	1	7p′	120601	2	4d′	2473.0423	
4048.6680	.0021	0.78	25	123262	2	7p	119213	3	4d	2469.2743	
4054.5812	.0015	1.15	42	122514	1	5d	118460	1	5p′	2465.6732	
4056.7341	.0018	1.35	79	122708	2	5f	118651	1	4d	2464.3646	
4097.4490	.0028	0.67	26	122610	1	6p′	118512	0	4d	2439.8771	
4106.7486	.0028	0.87	42	122514	1	5d	118407	1	5p′	2434.3521	
4139.1473	.0013	0.98	24	122791	0	6p′	118651	1	4d	2415.2974	
4161.9827	.0018	0.79	22	121161	1	6s′	116999	2	5p	2402.0455	
4163.2368	.0003	2.73	19	117184	2	5p	113020	3	3d	2401.3219	
4171.3499	.0003	4.34	18	111668	0	3d	107496	1	4p′	2396.6515	
4173.8640	.0005	1.83	57	122686	1	5f	118512	0	4d	2395.2079	
4182.1415	.0003	2.01	36	123206	3	7p	119024	4	4d	2390.4671	
4192.6019	.0003	4.81	19	116943	3	5p	112750	4	3d	2384.5030	
4193.5551	.0068	1.15	192	124041	2	6f	119848	1	4d	2383.9610	
4203.8383	.0075	1.14	206	124052	2	6f	119848	1	4d	2378.1295	
4259.7018	.0049	0.49	30	118407	1	5p′	114148	1	3d	2346.9417	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
4265.3208	.0023	0.97	42	123172	1	7*p*	118907	2	4*d*	2343.8499	
4311.8672	.0003	1.82	21	118460	1	5*p*′	114148	1	3*d*	2318.5481	
4321.6119	.0003	4.28	18	111818	1	3*d*	107496	1	4*p*′	2313.3201	
4348.2926	.0052	0.69	51	123255	1	7*p*	118907	2	4*d*	2299.1258	
4351.9215	.0003	2.82	23	121012	1	4*d*′	116660	1	5*p*	2297.2086	
4354.9209	.0005	1.65	45	123262	2	7*p*	118907	2	4*d*	2295.6264	
4369.8870	.0003	1.75	25	121933	1	5*d*	117563	0	5*p*	2287.7643	
4436.6086	.0003	2.07	22	121097	0	6*s*′	116660	1	5*p*	2253.3589	
4471.3904	.0205	0.42	108	125483	2	6*f*′	121012	1	4*d*′	2235.8307	
4480.5603	.0185	0.73	199	124047	4	6*f*	119566	3	4*d*	2231.2458	
4485.2981	.0166	0.79	205	124051	3	6*f*	119566	3	4*d*	2228.8980	
4492.1761	.0055	1.31	226	124058	4	6*f*	119566	3	4*d*	2225.4853	
4501.3157	.0003	1.92	22	121161	1	6*s*′	116660	1	5*p*	2220.9666	
4520.5363	.0012	1.22	41	123172	1	7*p*	118651	1	4*d*	2211.5234	
4521.0712	.0003	3.38	20	116660	1	5*p*	112139	2	3*d*	2211.2617	
4528.3284	.0003	4.26	19	111818	1	3*d*	107290	2	4*p*′	2207.7179	
4536.0578	.0003	3.65	19	111668	0	3*d*	107132	1	4*p*′	2203.9560	
4597.0516	.0042	0.59	33	123468	1	6*d*	118871	0	5*p*′	2174.7138	
4606.7673	.0388	0.54	269	124052	2	6*f*	119445	2	4*d*	2170.1273	
4621.1713	.1252	0.58	952	124871	[4.5]	7*g*	120250	[3.5]	4*f*	2163.3631	B
4639.8400	.1223	0.43	658	124870	[3.5]	7*g*	120230	[2.5]	4*f*	2154.6587	B
4642.5082	.0003	4.19	19	112139	2	3*d*	107496	1	4*p*′	2153.4203	
4659.7338	.0060	0.77	71	123172	1	7*p*	118512	0	4*d*	2145.4598	
4660.0886	.0303	0.80	382	124867	[5.5]	7*g*	120207	[4.5]	4*f*	2145.2964	B
4660.1418	.0150	0.80	189	124867	[5.5]	7*g*	120207	[4.5]	4*f*	2145.2719	B
4677.3691	.1915	0.25	681	124866	[2.5]	7*g*	120189	2	4*f*	2137.3707	B
4677.8035	.0695	0.10	175	124866	2	7*g*	120188	1	4*f*	2137.1722	
4686.3198	.0003	3.48	19	111818	1	3*d*	107132	1	4*p*′	2133.2883	
4723.1855	.0006	1.28	21	118871	0	5*p*′	114148	1	3*d*	2116.6375	
4729.1871	.0045	1.08	109	125483	3	6*f*′	120753	3	4*d*′	2113.9513	
4749.2522	.0003	1.67	26	121933	1	5*d*	117184	2	5*p*	2105.0201	
4752.4982	.0003	2.68	21	118469	2	5*p*′	113717	3	3*d*	2103.5823	
4763.7568	.0003	4.41	20	111818	1	3*d*	107054	0	4*p*	2098.6108	
4781.5173	.0013	0.98	24	121933	1	5*d*	117151	1	5*p*	2090.8157	
4803.8323	.0003	3.39	21	116943	3	5*p*	112139	2	3*d*	2081.1033	
4821.3722	.0003	2.75	23	120188	1	4*f*	115367	1	3*d*′	2073.3556	
4821.7833	.0003	3.37	23	120189	2	4*f*	115367	1	3*d*′	2073.3556	
4825.7921	.0003	2.64	21	118469	2	5*p*′	113643	1	5*s*	2071.6332	
4833.7383	.0043	1.32	179	124047	4	6*f*	119213	3	4*d*	2068.2276	
4841.9676	.0003	3.60	21	116660	1	5*p*	111818	1	3*d*	2064.7125	
4845.3393	.0496	0.42	261	124058	4	6*f*	119213	3	4*d*	2063.2758	
4849.2246	.0003	4.64	20	112139	2	3*d*	107290	2	4*p*′	2061.6226	
4860.4029	.0003	3.09	21	116999	2	5*p*	112139	2	3*d*	2056.8812	
4863.1981	.0003	1.91	24	120230	2	4*f*	115367	1	3*d*′	2055.6989	
4863.6156	.0498	0.52	330	125483	3	6*f*	120619	2	4*d*	2055.5225	
4881.7088	.0738	0.20	234	125483	3	6*f*′	120601	2	4*d*′	2047.9040	
4882.2183	.0619	0.39	304	125483	3	6*f*′	120601	2	4*d*′	2047.6903	
4903.3195	.0005	1.44	27	122087	2	5*d*	117184	2	5*p*	2038.8782	
4903.8743	.0022	0.90	34	123373	2	5*d*′	118469	2	5*p*′	2038.6475	
4913.3272	.0010	1.29	37	123373	2	5*d*′	118460	1	5*p*′	2034.7253	
4916.4170	.0006	1.46	34	122479	1	7*s*	117563	0	5*p*	2033.4465	
4920.6418	.0003	3.75	21	113643	1	5*s*	108723	0	4*p*′	2031.7006	
4933.5165	.0019	0.88	28	121933	1	5*d*	116999	2	5*p*	2026.3986	
4935.5840	.0013	0.84	18	122087	2	5*d*	117151	1	5*p*	2025.5498	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)
4938.9606	.0019	0.71	19	118407	1	$5p'$	113468	2	$5s$	2024.1650
4981.4677	.0003	2.88	22	118407	1	$5p'$	113426	2	$3d$	2006.8927
4991.1242	.0003	2.78	22	118460	1	$5p'$	113468	2	$5s$	2003.0098
4992.2295	.0003	3.21	22	116660	1	$5p$	111668	0	$3d$	2002.5664
5000.5785	.0003	2.12	22	118469	2	$5p'$	113468	2	$5s$	1999.2229
5007.2161	.0003	3.89	20	112139	2	$3d$	107132	1	$4p'$	1996.5727
5011.2612	.0069	0.43	37	123882	1	$7s'$	118871	0	$5p'$	1994.9610
5012.4035	.0003	3.09	22	117151	1	$5p$	112139	2	$3d$	1994.5064
5022.9444	.0055	1.19	171	124047	5	$6f$	119024	4	$4d$	1990.3208
5033.6355	.0004	1.57	22	118460	1	$5p'$	113426	2	$3d$	1986.0935
5043.0896	.0003	1.65	22	118469	2	$5p'$	113426	2	$3d$	1982.3703
5044.6682	.0003	4.11	22	117184	2	$5p$	112139	2	$3d$	1981.7499
5088.3662	.0024	0.76	27	123557	3	$5d'$	118469	2	$5p'$	1964.7310
5093.3095	.0003	2.01	28	122036	4	$5d$	116943	3	$5p$	1962.8241
5098.0554	.0013	1.03	28	123505	2	$5'$	118407	1	$5p'$	1960.9969
5134.1000	.0004	1.60	27	121794	0	$5d$	116660	1	$5p$	1947.2294
5134.7213	.0111	0.50	70							1946.9938
5143.9814	.0103	0.50	65							1943.4889
5144.1578	.0041	0.63	35	122087	2	$5d$	116943	3	$5p$	1943.4222
5144.7379	.0185	0.75	208	124051	3	$6f$	118907	2	$4d$	1943.2031
5160.8178	.0014	1.02	30	122160	3	$5d$	116999	2	$5p$	1937.1485
5181.2992	.0003	1.82	22	116999	2	$5p$	111818	1	$3d$	1929.4911
5213.2166	.0003	1.98	23	120188	1	$4f$	114975	1	$5s'$	1917.6779
5213.6287	.0003	2.34	24	120189	2	$4f$	114975	1	$5s'$	1917.5264
5227.6566	.0003	2.06	22	118871	0	$5p'$	113643	1	$5s$	1912.3809
5255.0438	.0008	1.18	24	120230	2	$4f$	114975	1	$5s'$	1902.4143
5256.4671	.0005	1.54	32	122440	2	$7s$	117184	2	$5p$	1901.8992
5288.7302	.0078	0.59	61	122440	2	$7s$	117151	1	$5p$	1890.2969
5295.7768	.0013	1.27	48	122479	1	$7s$	117184	2	$5p$	1887.7817
5325.3649	.0005	1.43	27	124349	3	$8p$	119024	4	$4d$	1877.2930
5326.5996	.0003	1.86	28	120188	1	$4f$	114862	0	$5s'$	1876.8579
5328.0407	.0008	1.47	43	122479	1	$7s$	117151	1	$5p$	1876.3502
5333.2985	.0003	2.75	26	117151	1	$5p$	111818	1	$3d$	1874.5005
5362.8422	.0017	1.30	69	122514	1	$5d$	117151	1	$5p$	1864.1739
5365.5629	.0003	3.03	26	117184	2	$5p$	111818	1	$3d$	1863.2286
5366.7097	.0005	1.50	27	120189	2	$4f$	114822	3	$3d'$	1862.8305
5383.1008	.0003	2.19	27	120188	1	$4f$	114805	2	$3d'$	1857.1583
5383.5132	.0003	3.06	28	120189	2	$4f$	114805	2	$3d'$	1857.0160
5385.2359	.0003	2.86	28	120207	4	$4f$	114822	3	$3d'$	1856.4220
5407.8144	.0003	2.69	28	120230	3	$4f$	114822	3	$3d'$	1848.6711
5408.1245	.0003	1.74	30	120230	2	$4f$	114822	3	$3d'$	1848.5651
5413.1355	.0010	1.40	50	123882	1	$7s'$	118469	2	$5p'$	1846.8539
5413.3861	.0029	0.96	52	123873	0	$7s'$	118460	1	$5p'$	1846.7684
5422.5872	.0031	0.93	52	123882	1	$7s'$	118460	1	$5p'$	1843.6348
5424.6185	.0003	3.57	28	120230	3	$4f$	114805	2	$3d'$	1842.9444
5424.9288	.0003	2.67	29	120230	2	$4f$	114805	2	$3d'$	1842.8390
5425.1122	.0003	3.97	25	114148	1	$3d$	108723	0	$4p'$	1842.7767
5426.9133	.0012	1.22	39	122087	2	$5d$	116660	1	$5p$	1842.1651
5427.9369	.0003	2.47	27	120250	3	$4f$	114822	3	$3d'$	1841.8177
5427.9759	.0003	3.22	29	120250	4	$4f$	114822	3	$3d'$	1841.8045
5440.7264	.0013	1.24	45	122440	2	$7s$	116999	2	$5p$	1837.4881
5444.7413	.0003	1.92	28	120250	3	$4f$	114805	2	$3d'$	1836.1332
5448.6962	.0003	2.34	27	118469	2	$5p'$	113020	3	$3d$	1834.8005
5465.5582	.0017	1.06	39	123873	0	$7s'$	118407	1	$5p'$	1829.1398

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)
5474.7706	.0003	1.96	31	123882	1	7s′	118407	1	5p′	1826.0619
5480.0418	.0004	1.86	44	122479	1	7s	116999	2	5p	1824.3055
5483.5605	.0003	2.20	26	117151	1	5p	111668	0	3d	1823.1348
5497.2964	.0003	2.08	44	122440	2	7s	116943	3	5p	1818.5794
5547.2429	.0006	1.41	27	120188	1	4f	114641	2	3d′	1802.2052
5547.6563	.0004	1.60	29	120189	2	4f	114641	2	3d′	1802.0709
5580.4771	.0003	4.46	25	111818	1	3d	106238	2	4p	1791.4723
5580.5079	.0003	2.47	20	111668	0	3d	106087	1	4p	1791.4624
5588.7614	.0003	2.38	29	120230	3	4f	114641	2	3d′	1788.8167
5589.0716	.0003	2.85	30	120230	2	4f	114641	2	3d′	1788.7175
5608.8840	.0003	3.51	29	120250	3	4f	114641	2	3d′	1782.3991
5730.6554	.0003	2.93	25	113020	3	3d	107290	2	4p′	1744.5247
5730.7691	.0003	3.79	25	111818	1	3d	106087	1	4p	1744.4901
5744.9275	.0003	2.90	28	117563	0	5p	111818	1	3d	1740.1907
5780.0583	.0004	1.80	45	122440	2	7s	116660	1	5p	1729.6140
5819.3713	.0022	1.09	53	122479	1	7s	116660	1	5p	1717.9295
5901.3725	.0003	5.09	26	112139	2	3d	106238	2	4p	1694.0584
5929.5467	.0003	2.22	26	113426	2	3d	107496	1	4p′	1686.0090
5972.0567	.0003	3.92	27	113468	2	5s	107496	1	4p′	1674.0078
6040.5042	.0003	2.79	31	120188	1	4f	114148	1	3d	1655.0388
6040.9167	.0003	3.72	32	120189	2	4f	114148	1	3d	1654.9258
6051.6654	.0003	4.19	27	112139	2	3d	106087	1	4p	1651.9864
6082.3322	.0003	4.02	33	120230	2	4f	114148	1	3d	1643.6572
6146.8432	.0003	2.85	28	113643	1	5s	107496	1	4p′	1626.4070
6178.7732	.0003	3.56	28	113468	2	5s	107290	2	4p′	1618.0022
6189.3304	.0010	1.49	63	123373	2	5d′	117184	2	5p	1615.2424
6200.7575	.0003	3.17	27	111818	1	3d	105617	2	4p	1612.2657
6252.3992	.0003	4.30	29	114975	1	5s′	108723	0	4p′	1598.9492
6263.6021	.0017	1.08	40	121069	1	6p	114805	2	3d′	1596.0894
6284.3870	.0073	0.80	92	123468	1	6d	117184	2	5p	1590.8105
6287.7156	.0003	3.84	34	121655	2	4f′	115367	1	3d′	1589.9683
6294.2547	.0003	3.22	28	113426	2	3d	107132	1	4p′	1588.3165
6320.6730	.0003	2.84	31	118460	1	5p′	112139	2	3d	1581.6779
6330.1276	.0003	2.39	30	118469	2	5p′	112139	2	3d	1579.3155
6336.7646	.0003	2.24	29	113468	2	5s	107132	1	4p′	1577.6613
6353.5597	.0003	2.75	29	113643	1	5s	107290	2	4p′	1573.4909
6354.1562	.0016	1.04	35	123505	2	5d′	117151	1	5p	1573.3432
6426.8546	.0003	2.55	28	113717	3	3d′	107290	2	4p′	1555.5460
6465.4784	.0020	0.97	37	121271	2	6p	114805	2	3d′	1546.2534
6472.0932	.0003	2.49	32	120189	2	4f	113717	3	3d	1544.6731
6490.6200	.0003	3.67	32	120207	4	4f	113717	3	3d	1540.2640
6495.2257	.0020	1.02	41	121470	0	6p	114975	1	5s′	1539.1718
6511.5511	.0003	3.50	30	113643	1	5s	107132	1	4p′	1535.3128
6513.1985	.0003	3.67	32	120230	3	4f	113717	3	3d	1534.9245
6513.5093	.0003	2.03	35	120230	2	4f	113717	3	3d	1534.8513
6521.6538	.0003	3.79	29	112139	2	3d	105617	2	4p	1532.9345
6533.3600	.0003	4.32	33	120250	4	4f	113717	3	3d	1530.1878
6544.9749	.0003	1.98	32	120188	1	4f	113643	1	5s	1527.4723
6545.3873	.0008	1.49	47	120189	2	4f	113643	1	5s	1527.3761
6558.0881	.0020	1.26	72	123557	3	5d′	116999	2	5p	1524.4181
6586.8027	.0003	2.24	35	120230	2	4f	113643	1	5s	1517.7725
6588.9881	.0003	4.27	30	113643	1	5s	107054	0	4p	1517.2691
6616.1631	.0020	1.17	60	121257	1	6p	114641	2	3d′	1511.0371
6641.5687	.0004	1.78	32	118460	1	5p′	111818	1	3d	1505.2570

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
6644.2443	.0003	4.82	31	115367	1	3*d*′	108723	0	4*p*′	1504.6505	
6651.0239	.0003	2.57	32	118469	2	5*p*′	111818	1	3*d*	1503.1171	
6651.3147	.0003	3.12	30	114148	1	3*d*	107496	1	4*p*′	1503.0514	
6676.1637	.0003	1.87	30	112139	2	3*d*	105463	3	4*p*	1497.4569	
6679.5614	.0003	2.16	34	121655	2	4*f*′	114975	1	5*s*′	1496.6952	
6710.4045	.0012	1.45	65	123653	4	6*d*	116943	3	5*p*	1489.8159	
6719.7626	.0005	1.58	31	120188	1	4*f*	113468	2	5*s*	1487.7412	
6720.1741	.0003	2.38	34	120189	2	4*f*	113468	2	5*s*	1487.6501	
6739.6641	.0003	2.10	33	118407	1	5*p*′	111668	0	3*d*	1483.3481	
6761.2791	.0003	2.92	33	120230	3	4*f*	113468	2	5*s*	1478.6060	
6761.5892	.0003	2.09	34	120230	2	4*f*	113468	2	5*s*	1478.5382	
6762.2723	.0003	2.24	33	120188	1	4*f*	113426	2	3*d*	1478.3888	
6762.6812	.0008	1.44	41	120189	2	4*f*	113426	2	3*d*	1478.2994	
6781.4033	.0005	1.64	38	120250	3	4*f*	113468	2	5*s*	1474.2181	
6782.8037	.0003	3.52	30	113020	3	3*d*	106238	2	4*p*	1473.9137	
6791.8316	.0003	2.23	32	118460	1	5*p*′	111668	0	3*d*	1471.9546	
6803.7904	.0003	2.41	34	120230	3	4*f*	113426	2	3*d*	1469.3674	
6804.1004	.0003	3.49	35	120230	2	4*f*	113426	2	3*d*	1469.3004	
6807.9810	.0018	1.34	78	123468	1	6*d*	116660	1	5*p*	1468.4629	
6823.9129	.0003	4.15	34	120250	3	4*f*	113426	2	3*d*	1465.0345	
6831.3425	.0003	4.14	34	121653	4	4*f*′	114822	3	3*d*′	1463.4411	
6832.2944	.0003	2.81	33	121654	3	4*f*′	114822	3	3*d*′	1463.2372	
6832.6383	.0004	1.91	37	121655	2	4*f*′	114822	3	3*d*′	1463.1645	
6848.1066	.0003	2.10	34	121653	3	4*f*′	114805	2	3*d*′	1459.8586	
6849.0986	.0003	3.90	34	121654	3	4*f*′	114805	2	3*d*′	1459.6472	
6849.4457	.0003	2.67	35	121655	2	4*f*′	114805	2	3*d*′	1459.5732	
6858.0314	.0003	2.68	31	114148	1	3*d*	107290	2	4*p*′	1457.7459	
6960.4610	.0016	1.05	36	123903	2	8*s*	116943	3	5*p*	1436.2938	
7012.2491	.0003	3.92	35	121653	3	4*f*′	114641	2	3*d*′	1425.6862	
7013.2417	.0007	1.42	35	121654	3	4*f*′	114641	2	3*d*′	1425.4845	
7013.5887	.0003	2.70	35	121655	2	4*f*′	114641	2	3*d*′	1425.4139	
7016.0228	.0003	3.86	32	114148	1	3*d*	107132	1	4*p*′	1424.9194	
7052.8888	.0003	2.11	34	118871	0	5*p*′	111818	1	3*d*	1417.4712	
7093.4598	.0003	4.80	33	114148	1	3*d*	107054	0	4*p*	1409.3640	
7109.4333	.0010	1.42	51	121257	1	6*p*	114148	1	3*d*	1406.1974	
7144.5754	.0003	2.55	31	114641	2	3*d*′	107496	1	4*p*′	1399.2807	
7168.2913	.0008	1.45	40	120189	2	4*f*	113020	3	3*d*	1394.6513	
7186.8195	.0003	4.16	36	120207	4	4*f*	113020	3	3*d*	1391.0558	
7188.4115	.0003	3.60	32	113426	2	3*d*	106238	2	4*p*	1390.7477	
7209.3980	.0003	2.40	35	120230	3	4*f*	113020	3	3*d*	1386.6992	
7209.7084	.0003	2.24	38	120230	2	4*f*	113020	3	3*d*	1386.6395	
7229.5208	.0003	3.32	36	120250	3	4*f*	113020	3	3*d*	1382.8394	
7229.5596	.0003	2.97	36	120250	4	4*f*	113020	3	3*d*	1382.8320	
7230.9218	.0003	4.20	33	113468	2	5*s*	106238	2	4*p*	1382.5715	
7287.3941	.0003	5.47	36	112750	4	3*d*	105463	3	4*p*	1371.8575	
7308.7184	.0003	4.92	33	114805	2	3*d*′	107496	1	4*p*′	1367.8549	
7319.5339	.0008	1.69	75	122686	2	5*f*	115367	1	3*d*′	1365.8337	B
7322.4961	.0007	1.58	47	121470	0	6*p*	114148	1	3*d*	1365.2812	
7338.7045	.0003	5.07	33	113426	2	3*d*	106087	1	4*p*	1362.2658	
7351.2921	.0003	4.23	33	114641	2	3*d*′	107290	2	4*p*′	1359.9332	
7365.2190	.0003	3.89	34	114862	0	5*s*′	107496	1	4*p*′	1357.3617	
7381.2145	.0003	3.74	33	113468	2	5*s*	106087	1	4*p*	1354.4202	
7403.0851	.0003	5.34	35	113020	3	3*d*	105617	2	4*p*	1350.4189	
7405.7081	.0003	4.18	34	113643	1	5*s*	106238	2	4*p*	1349.9406	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
7448.8049	.0014	1.18	40	121165	3	6p	113717	3	3d	1342.1302	
7456.9807	.0003	4.39	37	120207	5	4f	112750	4	3d	1340.6587	
7475.2491	.0012	1.35	51	121192	2	6p	113717	3	3d	1337.3823	
7478.6019	.0003	3.94	34	114975	1	5s′	107496	1	4p′	1336.7827	
7479.0030	.0003	5.23	35	113717	3	3d	106238	2	4p	1336.7110	
7479.5986	.0003	2.14	38	120230	3	4f	112750	4	3d	1336.6046	
7499.7604	.0003	3.41	37	120250	4	4f	112750	4	3d	1333.0114	
7506.8488	.0003	2.11	38	121655	2	4f′	114148	1	3d	1331.7527	
7509.2835	.0003	5.02	34	114641	2	3d′	107132	1	4p′	1331.3209	
7515.4349	.0003	3.45	33	114805	2	3d′	107290	2	4p′	1330.2312	
7532.2390	.0003	5.18	35	114822	3	3d′	107290	2	4p′	1327.2635	
7548.5433	.0004	1.81	41	121192	2	6p	113643	1	5s	1324.3967	
7554.0597	.0004	1.96	45	121271	2	6p	113717	3	3d	1323.4295	
7556.0010	.0003	4.42	34	113643	1	5s	106087	1	4p	1323.0895	
7557.5951	.0003	4.63	34	113020	3	3d	105463	3	4p	1322.8104	
7565.6667	.0003	4.59	33	111668	0	3d	104102	1	4p	1321.3992	
7600.2631	.0008	1.55	49	121069	1	6p	113468	2	5s	1315.3842	
7613.8980	.0005	1.70	39	121257	1	6p	113643	1	5s	1313.0286	
7626.2064	.0071	0.46	41	122601	1	6p′	114975	1	5s′	1310.9094	
7627.3559	.0010	1.36	44	121271	2	6p	113643	1	5s	1310.7118	
7660.0431	.0006	1.63	44	122635	2	6p′	114975	1	5s′	1305.1187	
7673.4263	.0003	3.23	34	114805	2	3d′	107132	1	4p′	1302.8424	
7685.3185	.0003	4.60	35	114975	1	5s′	107290	2	4p′	1300.8264	
7696.8884	.0004	2.07	43	121165	3	6p	113468	2	5s	1298.8710	
7715.9287	.0003	4.94	34	111818	1	3d	104102	1	4p	1295.6659	
7729.9269	.0003	4.09	35	114862	0	5s′	107132	1	4p′	1293.3195	
7748.0090	.0131	0.16	38	122610	1	6p′	114862	0	5s′	1290.3012	
7765.8417	.0010	1.45	51	121192	2	6p	113426	2	3d	1287.3383	
7802.1377	.0004	1.81	41	121271	2	6p	113468	2	5s	1281.3495	
7808.6929	.0003	4.72	35	113426	2	3d	105617	2	4p	1280.2738	
7813.1258	.0005	1.77	48	122635	2	6p′	114822	3	3d′	1279.5474	
7815.5226	.0012	1.42	62	122791	0	6p′	114975	1	5s′	1279.1550	
7826.9723	.0005	1.78	46	121470	0	6p	113643	1	5s	1277.2838	
7831.1933	.0006	1.68	50	121257	1	6p	113426	2	3d	1276.5954	
7843.3100	.0003	3.86	36	114975	1	5s′	107132	1	4p′	1274.6232	
7851.2029	.0003	4.04	35	113468	2	5s	105617	2	4p	1273.3418	
7870.4485	.0003	4.64	36	115367	1	3d′	107496	1	4p′	1270.2281	
7873.7454	.0047	0.74	51							1269.6962	
7881.2694	.0037	0.88	56	122686	2	5f	114805	2	3d′	1268.4841	
7895.9030	.0065	0.91	105	122718	4	5f	114822	3	3d′	1266.1332	B
7902.7445	.0047	0.74	51	122708	3	5f	114805	2	3d′	1265.0371	
7910.1795	.0003	2.89	36	114148	1	3d	106238	2	4p	1263.8480	
7920.7469	.0003	3.15	36	114975	1	5s′	107054	0	4p	1262.1619	
7936.7267	.0003	2.65	39	121653	4	4f′	113717	3	3d	1259.6206	
7937.6794	.0008	1.31	31	121654	3	4f′	113717	3	3d	1259.4695	
7963.2029	.0003	3.11	35	113426	2	3d	105463	3	4p	1255.4326	
7968.6520	.0011	1.27	38	122610	1	6p′	114641	2	3d′	1254.5741	
8005.7130	.0003	4.88	38	113468	2	5s	105463	3	4p	1248.7663	
8025.9896	.0003	4.66	37	113643	1	5s	105617	2	4p	1245.6114	
8036.8250	.0003	4.85	36	112139	2	3d	104102	1	4p	1243.9321	
8049.3114	.0003	2.25	38	120188	1	4f	112139	2	3d	1242.0024	
8049.7243	.0003	3.23	39	120189	2	4f	112139	2	3d	1241.9387	
8060.4725	.0003	4.78	37	114148	1	3d	106087	1	4p	1240.2827	
8076.8285	.0027	1.10	68	122718	3	5f	114641	2	3d′	1237.7710	

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
8090.8295	.0003	3.78	39	120230	3	4f	112139	2	3d	1235.6291	
8091.1398	.0003	2.66	40	120230	2	4f	112139	2	3d	1235.5817	
8099.2843	.0003	4.22	36	113717	3	3d	105617	2	4p	1234.3392	
8145.0037	.0022	1.08	52	121165	3	6p	113020	3	3d	1227.4106	
8171.4491	.0004	1.98	46	121192	2	6p	113020	3	3d	1223.4383	
8185.7581	.0012	1.37	56	121654	3	4f′	113468	2	5s	1221.2997	
8227.2780	.0003	3.02	40	121653	3	4f′	113426	2	3d	1215.1363	
8228.2703	.0006	1.48	33	121654	3	4f′	113426	2	3d	1214.9898	
8228.6167	.0005	1.72	40	121655	2	4f′	113426	2	3d	1214.9386	
8235.1565	.0003	4.34	38	115367	1	3d′	107132	1	4p′	1213.9738	
8253.7944	.0003	4.50	37	113717	3	3d	105463	3	4p	1211.2325	
8312.5935	.0003	3.38	38	115367	1	3d′	107054	0	4p	1202.6648	
8370.2083	.0003	3.26	40	120188	1	4f	111818	1	3d	1194.3865	
8370.6209	.0003	3.51	41	120189	2	4f	111818	1	3d	1194.3276	
8403.4405	.0003	2.80	37	114641	2	3d′	106238	2	4p	1189.6632	
8412.0363	.0003	3.00	42	120230	2	4f	111818	1	3d	1188.4475	
8415.2098	.0004	2.10	46	121165	3	6p	112750	4	3d	1187.9993	
8520.4703	.0003	3.32	40	120188	1	4f	111668	0	3d	1173.3229	
8530.4611	.0003	3.61	38	114148	1	3d	105617	2	4p	1171.9488	
8538.3141	.0034	0.95	60	122686	1	5f	114148	1	3d	1170.8709	
8538.6632	.0013	1.62	103	122686	2	5f	114148	1	3d	1170.8230	
8553.7333	.0003	2.65	38	114641	2	3d′	106087	1	4p	1168.7602	
8560.3877	.0005	2.38	158	122708	2	5f	114148	1	3d	1167.8517	
8567.5832	.0003	4.33	38	114805	2	3d′	106238	2	4p	1166.8709	
8584.3886	.0013	1.18	37	114822	3	3d′	106238	2	4p	1164.5865	
8632.9262	.0003	2.59	42	121653	4	4f′	113020	3	3d	1158.0387	
8633.8790	.0011	1.32	44	121654	3	4f′	113020	3	3d	1157.9109	
8702.2714	.0003	4.13	39	104102	1	4p	95400	1	4s′	1148.8107	
8717.8762	.0003	3.34	38	114805	2	3d′	106087	1	4p	1146.7544	
8737.4668	.0003	3.70	39	114975	1	5s′	106238	2	4p	1144.1832	
8770.5680	.0093	0.79	115	124137	2	5f′	115367	1	3d′	1139.8649	
8774.3768	.0004	3.31	39	114862	0	5s′	106087	1	4p	1139.3701	
8887.7599	.0004	2.03	40	114975	1	5s′	106087	1	4p	1124.8349	
8929.8069	.0025	0.90	40	121069	1	6p	112139	2	3d	1119.5384	
8979.1216	.0014	1.61	112	122696	4	5f	113717	3	3d	1113.3898	
8991.3269	.0228	0.42	120	122708	3	5f	113717	3	3d	1111.8784	
9001.2763	.0008	2.10	166	122718	3	5f	113717	3	3d	1110.6494	
9023.7218	.0004	3.63	40	114641	2	3d′	105617	2	4p	1107.8868	
9026.4358	.0029	0.89	45	121165	3	6p	112139	2	3d	1107.5536	
9118.2337	.0024	0.97	45	121257	1	6p	112139	2	3d	1096.4033	
9129.3133	.0004	3.24	41	115367	1	3d′	106238	2	4p	1095.0727	
9131.6914	.0005	1.81	49	121271	2	6p	112139	2	3d	1094.7875	
9175.2882	.0004	2.17	45							1089.5855	
9178.2318	.0004	2.55	40	114641	2	3d′	105463	3	4p	1089.2361	
9187.8647	.0004	3.39	40	114805	2	3d′	105617	2	4p	1088.0941	
9204.6688	.0004	2.35	41	114822	3	3d′	105617	2	4p	1086.1077	
9250.7077	.0011	1.37	48	121069	1	6p	111818	1	3d	1080.7023	
9279.6063	.0004	2.63	42	115367	1	3d′	106087	1	4p	1077.3368	
9282.1503	.0037	1.33	158	122708	2	5f	113426	2	3d	1077.0415	
9313.7480	.0007	2.03	130	124136	4	5f′	114822	3	3d′	1073.3875	
9315.2458	.0076	0.85	107	124137	3	5f′	114822	3	3d′	1073.2149	?
9323.8646	.0005	1.74	41	113426	2	3d	104102	1	4p	1072.2229	
9332.0600	.0011	1.80	124	124137	3	5f′	114805	2	3d′	1071.2813	
9342.3745	.0004	2.87	41	114805	2	3d′	105463	3	4p	1070.0985	

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
9357.7483	.0004	2.55	42	114975	1	5*s*′	105617	2	4*p*	1068.3404	
9359.1787	.0004	3.80	41	114822	3	3*d*′	105463	3	4*p*	1068.1771	
9366.3742	.0004	4.52	43	113468	2	5*s*	104102	1	4*p*	1067.3565	
9400.9699	.0020	1.18	60	121069	1	6*p*	111668	0	3*d*	1063.4286	
9439.1217	.0012	1.33	47	121257	1	6*p*	111818	1	3*d*	1059.1304	
9452.5840	.0022	1.15	61	121271	2	6*p*	111818	1	3*d*	1057.6220	
9494.6660	.0005	2.14	77	124136	3	5*f*′	114641	2	3*d*′	1052.9344	
9515.3098	.0004	2.95	45	121654	3	4*f*′	112139	2	3*d*	1050.6500	
9515.6569	.0005	1.84	48	121655	2	4*f*′	112139	2	3*d*	1050.6117	
9541.1608	.0004	3.95	43	113643	1	5*s*	104102	1	4*p*	1047.8034	
9548.4347	.0004	4.73	42	104102	1	4*p*	94554	0	4*s*′	1047.0051	
9675.3296	.0005	2.39	113	122696	4	5*f*	113020	3	3*d*	1033.2743	
9697.4736	.0021	1.57	151	122718	3	5*f*	113020	3	3*d*	1030.9155	
9749.5947	.0004	2.06	45	115367	1	3*d*′	105617	2	4*p*	1025.4026	
9836.5531	.0004	2.27	48	121655	2	4*f*′	111818	1	3*d*	1016.3377	
9928.7757	.0004	2.21	45	118651	1	4*d*	108723	0	4*p*′	1006.8975	
9945.4830	.0004	2.57	114	122696	5	5*f*	112750	4	3*d*	1005.2060	
9967.6693	.0033	1.45	182	122718	3	5*f*	112750	4	3*d*	1002.9686	
10200.3194	.0055	0.70	55	123221	2	7*p*	113020	3	3*d*	980.0927	
10217.4425	.0004	4.55	49	105617	2	4*p*	95400	1	4*s*′	978.4502	
10341.7253	.0072	0.90	114	124058	3	6*f*	113717	3	3*d*	966.6915	B
10351.5020	.0004	4.80	58	104102	1	4*p*	93751	1	4*s*	965.7785	
10419.1483	.0062	0.75	69	124136	4	5*f*′	113717	3	3*d*	959.5081	
10455.6379	.0034	0.87	50	123206	3	7*p*	112750	4	3*d*	956.1595	
10547.4896	.0012	1.58	84	122686	2	5*f*	112139	2	3*d*	947.8328	
10569.2113	.0045	0.95	79	122708	2	5*f*	112139	2	3*d*	945.8849	
10632.2932	.0082	0.90	130	124058	3	6*f*	113426	2	3*d*	940.2729	B
10660.7525	.0258	0.68	247	125483	4	6*f*′	114822	3	3*d*′	937.7628	
10678.0032	.0110	0.62	92	125483	3	6*f*′	114805	2	3*d*′	936.2478	
10687.4309	.0004	4.14	48	106087	1	4*p*	95400	1	4*s*′	935.4219	
10703.0310	.0031	0.90	48	114805	2	3*d*′	104102	1	4*p*	934.0579	
10709.7104	.0031	1.11	80	124136	3	5*f*′	113426	2	3*d*	933.4763	
10759.5356	.0004	3.02	47	114862	0	5*s*′	104102	1	4*p*	929.1530	
10837.7237	.0004	4.62	63	106238	2	4*p*	95400	1	4*s*′	922.4498	
10841.6683	.0175	0.68	167	125483	3	6*f*′	114641	2	3*d*′	922.1142	B
10868.0457	.0010	1.61	71	122686	1	5*f*	111818	1	3*d*	919.8770	
10868.3873	.0007	1.86	71	122686	2	5*f*	111818	1	3*d*	919.8479	
10872.9204	.0004	3.27	47	114975	1	5*s*′	104102	1	4*p*	919.4637	
10890.1131	.0023	1.25	81	122708	2	5*f*	111818	1	3*d*	918.0127	
10958.3386	.0007	5.89	71	104102	1	4*p*	93144	2	4*s*	912.2990	
11015.7819	.0005	2.13	49	118512	0	4*d*	107496	1	4*p*′	907.5393	
11018.3070	.0009	1.64	70	122686	1	5*f*	111668	0	3*d*	907.3319	
11037.5531	.0027	1.03	57	119760	1	6*s*	108723	0	4*p*′	905.7492	
11154.9795	.0009	1.52	48	118651	1	4*d*	107496	1	4*p*′	896.2145	
11264.7696	.0030	0.86	43	115367	1	3*d*′	104102	1	4*p*	887.4797	
11296.4703	.0036	1.34	157	124047	5	6*f*	112750	4	3*d*	884.9917	?
11361.6963	.0005	1.97	49	118651	1	4*d*	107290	2	4*p*′	879.9086	
11380.4908	.0017	1.23	54	118512	0	4*d*	107132	1	4*p*′	878.4554	
11410.1956	.0005	2.39	49	118907	2	4*d*	107496	1	4*p*′	876.1685	
11519.6873	.0006	1.74	49	118651	1	4*d*	107132	1	4*p*′	867.8407	
11533.5942	.0005	4.18	51	106087	1	4*p*	94554	0	4*s*′	866.7943	
11597.1244	.0005	2.19	50	118651	1	4*d*	107054	0	4*p*	862.0459	
11616.9120	.0005	2.37	50	118907	2	4*d*	107290	2	4*p*′	860.5775	
11654.4522	.0032	0.86	46	107054	0	4*p*	95400	1	4*s*′	857.8055	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
11731.8805	.0005	4.28	73	107132	1	$4p'$	95400	1	$4s'$	852.1441	
11774.9031	.0011	1.38	46	118907	2	$4d$	107132	1	$4p'$	849.0306	
11840.2156	.0157	0.55	111	124861	4	$7f$	113020	3	$3d$	844.3472	?
11866.6727	.0005	4.27	112	105617	2	$4p$	93751	1	$4s$	842.4647	R
11889.8716	.0005	4.25	105	107290	2	$4p'$	95400	1	$4s'$	840.8209	R
11912.4488	.0055	0.93	94	124051	3	$6f$	112139	2	$3d$	839.2273	?
11912.7258	.0130	0.22	43	124052	2	$6f$	112139	2	$3d$	839.2078	B
11923.1757	.0007	1.66	51	119213	3	$4d$	107290	2	$4p'$	838.4723	
11998.2807	.0071	0.77	83	124137	3	$5f'$	112139	2	$3d$	833.2237	
12096.5884	.0005	4.16	76	107496	1	$4p'$	95400	1	$4s'$	826.4521	
12186.6678	.0028	1.00	55	119683	2	$6s$	107496	1	$4p'$	820.3433	
12313.1259	.0010	1.50	54	119445	2	$4d$	107132	1	$4p'$	811.9182	
12318.9991	.0005	4.22	141	105463	3	$4p$	93144	2	$4s$	811.5311	R
12336.6612	.0005	4.22	100	106087	1	$4p$	93751	1	$4s$	810.3692	R
12351.3487	.0027	0.97	50	119848	1	$4d$	107496	1	$4p'$	809.4056	
12393.3829	.0020	1.12	51	119683	2	$6s$	107290	2	$4p'$	806.6603	
12413.8443	.0005	2.08	53	118651	1	$4d$	106238	2	$4p$	805.3307	
12424.9399	.0008	1.60	53	118512	0	$4d$	106087	1	$4p$	804.6115	
12438.6957	.0017	1.28	62	121161	1	$6s'$	108723	0	$4p'$	803.7217	
12473.5104	.0005	4.32	87	105617	2	$4p$	93144	2	$4s$	801.4785	R
12486.9545	.0005	4.24	66	106238	2	$4p$	93751	1	$4s$	800.6155	
12578.0436	.0005	4.25	83	107132	1	$4p'$	94554	0	$4s'$	794.8175	R
12628.4665	.0023	1.08	55	119760	1	$6s$	107132	1	$4p'$	791.6440	
12669.0604	.0005	2.19	53	118907	2	$4d$	106238	2	$4p$	789.1074	
12705.9011	.0012	1.42	56	119760	1	$6s$	107054	0	$4p$	786.8194	
12716.0561	.0032	0.95	57	119848	1	$4d$	107132	1	$4p'$	786.1910	
12793.4975	.0047	0.86	68	119848	1	$4d$	107054	0	$4p$	781.4326	
12819.3559	.0016	1.22	52	118907	2	$4d$	106087	1	$4p$	779.8556	
12942.7518	.0005	4.16	73	107496	1	$4p'$	94554	0	$4s'$	772.4206	
12943.4991	.0005	4.21	63	106087	1	$4p$	93144	2	$4s$	772.3760	
12975.3203	.0023	1.00	45	119213	3	$4d$	106238	2	$4p$	770.4818	
13034.1248	.0009	1.54	55	118651	1	$4d$	105617	2	$4p$	767.0057	
13093.7911	.0005	4.19	123	106238	2	$4p$	93144	2	$4s$	763.5105	R
13104.4750	.0010	1.52	59	120601	2	$4d'$	107496	1	$4p'$	762.8880	
13122.6038	.0008	1.77	64	120619	2	$4d'$	107496	1	$4p'$	761.8335	B
13210.2160	.0058	0.82	76	121933	1	$5d$	108723	0	$4p'$	756.7815	
13303.6742	.0005	4.23	80	107054	0	$4p$	93751	1	$4s$	751.4651	
13311.1897	.0009	1.61	54	120601	2	$4d'$	107290	2	$4p'$	751.0408	
13322.7911	.0005	4.35	75	108723	0	$4p'$	95400	1	$4s'$	750.3868	
13328.4986	.0017	1.26	57	119566	3	$4d$	106238	2	$4p$	750.0655	
13357.5779	.0007	1.81	56	119445	2	$4d$	106087	1	$4p$	748.4326	
13381.1108	.0006	2.05	54	107132	1	$4p'$	93751	1	$4s$	747.1163	
13443.8523	.0008	1.69	54	118907	2	$4d$	105463	3	$4p$	743.6297	
13445.5300	.0006	2.15	56	119683	2	$6s$	106238	2	$4p$	743.5369	
13463.7726	.0008	1.64	56	120753	3	$4d'$	107290	2	$4p'$	742.5294	
13469.1842	.0040	0.87	58	120601	2	$4d'$	107132	1	$4p'$	742.2311	
13487.3079	.0008	1.68	55	120619	2	$4d'$	107132	1	$4p'$	741.2337	
13522.6205	.0007	1.87	56	119760	1	$6s$	106238	2	$4p$	739.2980	
13539.1027	.0005	4.26	82	107290	2	$4p'$	93751	1	$4s$	738.3980	
13560.8872	.0005	2.81	56	119024	4	$4d$	105463	3	$4p$	737.2118	
13595.6041	.0006	2.36	57	119213	3	$4d$	105617	2	$4p$	735.3293	
13595.8213	.0016	1.25	54	119683	2	$6s$	106087	1	$4p$	735.3176	
13600.1892	.0015	1.27	52	121097	0	$6s'$	107496	1	$4p'$	735.0814	
13664.8971	.0007	1.84	57	121161	1	$6s'$	107496	1	$4p'$	731.6006	

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Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)
13672.9133	.0006	2.07	57	119760	1	6*s*	106087	1	4*p*	731.1716
13722.2228	.0029	1.03	60	121012	1	4*d*′	107290	2	4*p*′	728.5442
13745.8191	.0005	3.80	58	107496	1	4*p*′	93751	1	4*s*	727.2936
13750.1138	.0011	1.46	53	119213	3	4*d*	105463	3	4*p*	727.0664
13760.5079	.0010	1.55	62	119848	1	4*d*	106087	1	4*p*	726.5172
13827.5643	.0033	0.91	53	119445	2	4*d*	105617	2	4*p*	722.9943
13871.6141	.0006	2.27	57	121161	1	6*s*′	107290	2	4*p*′	720.6981
13957.6474	.0038	0.98	71	121012	1	4*d*′	107054	0	4*p*	716.2561
13964.8985	.0009	1.65	61	121097	0	6*s*′	107132	1	4*p*′	715.8838
13987.9487	.0006	3.50	56	107132	1	4*p*′	93144	2	4*s*	714.7041
14029.6054	.0008	1.77	59	121161	1	6*s*′	107132	1	4*p*′	712.5820
14065.8104	.0007	1.85	57	119683	2	6*s*	105617	2	4*p*	710.7478
14107.0439	.0022	1.10	53	121161	1	6*s*′	107054	0	4*p*	708.6704
14142.9014	.0006	2.42	58	119760	1	6*s*	105617	2	4*p*	706.8736
14145.9401	.0006	4.23	68	107290	2	4*p*′	93144	2	4*s*	706.7218
14220.3212	.0006	2.62	59	119683	2	6*s*	105463	3	4*p*	703.0252
14297.6829	.0026	1.10	64	121794	0	5*d*	107496	1	4*p*′	699.2212
14352.6567	.0006	4.17	70	107496	1	4*p*′	93144	2	4*s*	696.5430
14363.3400	.0011	1.48	59	120601	2	4*d*′	106238	2	4*p*	696.0250
14381.4656	.0012	1.44	59	120619	2	4*d*′	106238	2	4*p*	695.1477
14410.0995	.0006	2.34	59	118512	0	4*d*	104102	1	4*p*	693.7664
14513.6311	.0010	1.56	59	120601	2	4*d*′	106087	1	4*p*	688.8175
14515.9204	.0017	1.22	53	120753	3	4*d*′	106238	2	4*p*	688.7088
14531.7581	.0014	1.37	59	120619	2	4*d*′	106087	1	4*p*	687.9582
14549.2966	.0006	2.74	59	118651	1	4*d*	104102	1	4*p*	687.1289
14643.1510	.0030	1.06	68	121933	1	5*d*	107290	2	4*p*′	682.7248
14774.3674	.0011	1.52	62	121012	1	4*d*′	106238	2	4*p*	676.6612
14797.2184	.0019	1.27	66	122087	2	5*d*	107290	2	4*p*′	675.6165
14801.1458	.0057	0.75	64	121933	1	5*d*	107132	1	4*p*′	675.4370
14804.5129	.0006	2.72	60	118907	2	4*d*	104102	1	4*p*	675.2834
14878.5769	.0030	1.07	70	121933	1	5*d*	107054	0	4*p*	671.9218
14923.7635	.0022	1.16	61	121161	1	6*s*′	106238	2	4*p*	669.8874
14972.0217	.0006	2.62	59	108723	0	4*p*′	93751	1	4*s*	667.7281
15001.7457	.0017	1.28	59	120619	2	4*d*′	105617	2	4*p*	666.4051
15009.3499	.0020	1.15	55	121097	0	6*s*′	106087	1	4*p*	666.0675
15136.2016	.0010	1.60	61	120753	3	4*d*′	105617	2	4*p*	660.4854
15290.7116	.0016	1.33	61	120753	3	4*d*′	105463	3	4*p*	653.8112
15394.6522	.0056	0.81	72	121012	1	4*d*′	105617	2	4*p*	649.3968
15459.9161	.0085	0.78	102	122514	1	5*d*	107054	0	4*p*	646.6554
15544.0411	.0039	0.88	59	121161	1	6*s*′	105617	2	4*p*	643.1556
15580.9823	.0006	2.35	64	119683	2	6*s*	104102	1	4*p*	641.6307
15658.0726	.0008	1.75	63	119760	1	6*s*	104102	1	4*p*	638.4717
15695.2938	.0020	1.27	69	121933	1	5*d*	106238	2	4*p*	636.9576
15706.8445	.0044	0.94	75	121794	0	5*d*	106087	1	4*p*	636.4892
15849.3651	.0012	1.50	67	122087	2	5*d*	106238	2	4*p*	630.7657
15876.5080	.0020	1.33	83	123373	2	5*d*′	107496	1	4*p*′	629.6866
16083.2263	.0029	1.08	68	123373	2	5*d*′	107290	2	4*p*′	621.5939
16092.1163	.0017	1.36	71	122330	3	5*d*	106238	2	4*p*	621.2505
16194.8413	.0015	1.40	66	122282	2	5*d*	106087	1	4*p*	617.3098
16202.5128	.0020	1.26	69	122440	2	7*s*	106238	2	4*p*	617.0175
16215.7974	.0077	0.70	77	123505	2	5*d*′	107290	2	4*p*′	616.5120
16241.8345	.0046	0.93	77	122479	1	7*s*	106238	2	4*p*	615.5237
16267.7212	.0017	1.32	66	123557	3	5*d*′	107290	2	4*p*′	614.5442
16373.7785	.0016	1.36	68	123505	2	5*d*′	107132	1	4*p*′	610.5636

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)	
16376.5857	.0057	0.83	76	123873	0	7*s*′	107496	1	4*p*′	610.4589	
16392.1213	.0025	1.20	77	122479	1	7*s*	106087	1	4*p*	609.8804	
16498.7909	.0009	1.74	67	120601	2	4*d*′	104102	1	4*p*	605.9373	
16516.9178	.0015	1.41	69	120619	2	4*d*′	104102	1	4*p*	605.2723	
16542.8781	.0008	1.93	70	122160	3	5*d*	105617	2	4*p*	604.3224	
16573.3095	.0007	2.33	69	122036	4	5*d*	105463	3	4*p*	603.2128	
16592.5002	.0035	0.97	65	123882	1	7*s*′	107290	2	4*p*′	602.5151	
16624.1544	.0044	0.87	65	122087	2	5*d*	105463	3	4*p*	601.3678	
16697.3880	.0026	1.10	62	122160	3	5*d*	105463	3	4*p*	598.7303	
16822.7950	.0039	0.93	66	122440	2	7*s*	105617	2	4*p*	594.2669	
16862.1077	.0015	1.43	75	122479	1	7*s*	105617	2	4*p*	592.8814	
16909.8197	.0008	1.97	70	121012	1	4*d*′	104102	1	4*p*	591.2086	
16977.3094	.0012	1.70	105	122440	2	7*s*	105463	3	4*p*	588.8580	
16994.5069	.0015	1.39	66	121097	0	6*s*′	104102	1	4*p*	588.2624	
17059.2146	.0014	1.44	68	121161	1	6*s*′	104102	1	4*p*	586.0311	
17135.3729	.0036	0.99	69	123373	2	5*d*′	106238	2	4*p*	583.4264	
17319.8714	.0076	0.89	117	123557	3	5*d*′	106238	2	4*p*	577.2118	
17418.2292	.0019	1.26	66	123505	2	5*d*′	106087	1	4*p*	573.9520	
17692.0003	.0011	1.65	74	121794	0	5*d*	104102	1	4*p*	565.0704	
17830.7477	.0008	1.95	72	121933	1	5*d*	104102	1	4*p*	560.6734	
17940.1488	.0018	1.36	78	123557	3	5*d*′	105617	2	4*p*	557.2543	
17984.8161	.0009	1.86	73	122087	2	5*d*	104102	1	4*p*	555.8703	
18156.5910	.0043	1.02	88	123774	3	6*d*	105617	2	4*p*	550.6113	B
18190.4151	.0012	1.66	82	123653	4	6*d*	105463	3	4*p*	549.5875	
18337.9668	.0020	1.33	79	122440	2	7*s*	104102	1	4*p*	545.1655	
19147.0962	.0060	1.03	128	124610	4	7*d*	105463	3	4*p*	522.1271	
19270.8283	.0016	1.51	87	123373	2	5*d*′	104102	1	4*p*	518.7746	
19365.8730	.0018	1.41	81	123468	1	6*d*	104102	1	4*p*	516.2284	
19406.8306	.0052	0.95	91	123509	0	6*d*	104102	1	4*p*	515.1390	
19757.0357	.0198	0.74	217	125220	4	8*d*	105463	3	4*p*	506.0078	
21260.1678	.0012	1.67	85	116660	1	5*p*	95400	1	4*s*′	470.2316	
21599.5004	.0021	1.35	85	116999	2	5*p*	95400	1	4*s*′	462.8441	
21751.5042	.0016	1.54	90	117151	1	5*p*	95400	1	4*s*′	459.6096	
22106.3349	.0015	1.54	87	116660	1	5*p*	94554	0	4*s*′	452.2322	
22163.1303	.0009	2.17	89	117563	0	5*p*	95400	1	4*s*′	451.0733	
22909.3977	.0070	0.82	92	116660	1	5*p*	93751	1	4*s*	436.3793	
23007.6035	.0012	1.77	93	118407	1	5*p*′	95400	1	4*s*′	434.5168	
23059.7718	.0012	1.81	92	118460	1	5*p*′	95400	1	4*s*′	433.5338	
23069.2269	.0010	2.25	94	118469	2	5*p*′	95400	1	4*s*′	433.3561	
23248.7308	.0010	2.29	94	116999	2	5*p*	93751	1	4*s*	430.0101	
23400.7318	.0010	2.38	93	117151	1	5*p*	93751	1	4*s*	427.2169	
23432.9967	.0010	2.13	93	117184	2	5*p*	93751	1	4*s*	426.6286	
23471.0911	.0010	2.45	95	118871	0	5*p*′	95400	1	4*s*′	425.9362	
23516.2369	.0015	1.59	94	116660	1	5*p*	93144	2	4*s*	425.1185	
23798.9979	.0010	2.76	96	116943	3	5*p*	93144	2	4*s*	420.0674	
23812.3612	.0010	2.50	95	117563	0	5*p*	93751	1	4*s*	419.8317	
23853.7677	.0011	1.98	96	118407	1	5*p*′	94554	0	4*s*′	419.1029	
23855.5677	.0010	2.13	95	116999	2	5*p*	93144	2	4*s*	419.0713	
23905.9348	.0011	1.97	94	118460	1	5*p*′	94554	0	4*s*′	418.1883	
24007.5691	.0011	1.89	95	117151	1	5*p*	93144	2	4*s*	416.4179	
24039.8337	.0010	2.76	97	117184	2	5*p*	93144	2	4*s*	415.8590	
24656.8287	.0103	0.77	121	118407	1	5*p*′	93751	1	4*s*	405.4527	
24709.0026	.0065	0.89	100	118460	1	5*p*′	93751	1	4*s*	404.5965	
24718.4566	.0011	1.97	99	118469	2	5*p*′	93751	1	4*s*	404.4418	

Table 1. Ar I lines observed in the hollow cathode spectrum. The vacuum wavenumber (cm^{-1}) in the first column has been converted to wavelength in standard air in the last column. Upper and lower levels are identified by the integer part of the level energy in cm^{-1}, J-value (or [K]-value if individual J levels are not resolved), and configuration. Descriptive notes at the far right are as follows: B = blended line; R = reversed; ? = uncertain classification—Continued

Wavenumber (cm^{-1})	Unc. (cm^{-1})	log (S/N)	FWHM (10^{-3} cm^{-1})	Upper level[a] (cm^{-1})			Lower level[a] (cm^{-1})			Wavelength (nm)
25120.3269	.0085	0.76	71	118871	0	$5p'$	93751	1	$4s$	397.9715
25315.8403	.0013	1.79	99	118460	1	$5p'$	93144	2	$4s$	394.8979
25325.2989	.0034	1.17	96	118469	2	$5p'$	93144	2	$4s$	394.7504
25668.9124	.0063	1.29	86	121069	1	$6p$	95400	1	$4s'$	389.4560
26070.4161	.0060	1.99	84	121470	0	$6p$	95400	1	$4s'$	383.4678
26515.0764	.0063	1.41	86	121069	1	$6p$	94554	0	$4s'$	377.0368
27085.9965	.0066	1.35	86	120230	3	$4f$	93144	2	$4s$	369.0894
27318.1447	.0068	1.25	89	121069	1	$6p$	93751	1	$4s$	365.9529
27390.7207	.0064	1.70	86	122791	0	$6p'$	95400	1	$4s'$	364.9832
27506.5746	.0165	0.52	109	121257	1	$6p$	93751	1	$4s$	363.4459
27520.0268	.0064	1.56	83	121271	2	$6p$	93751	1	$4s$	363.2682
27719.6402	.0091	0.72	95	121470	0	$6p$	93751	1	$4s$	360.6522
27985.2236	.0068	1.33	95	123385	0	$7p$	95400	1	$4s'$	357.2295
28021.6135	.0064	1.96	86	121165	3	$6p$	93144	2	$4s$	356.7655
28126.8637	.0062	0.95	109	121271	2	$6p$	93144	2	$4s$	355.4305
29634.4517	.0075	1.15	87	123385	0	$7p$	93751	1	$4s$	337.3482
30117.7873	.0077	1.12	95	123262	2	$7p$	93144	2	$4s$	331.9342

[a] The notation nl (e.g., $6p$) denotes levels of the $3p^5nl$ configuration with $3p^5(^2P_{3/2})$ core. The notation nl' (e.g., $6p'$) denotes levels of the $3p^5nl$ configuration with $3p^5(^2P_{1/2})$ core.

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5. References

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